

**ESSAYS ON INSTITUTIONS FOR FACILITATING COOPERATION IN  
THE PROVISION OF PUBLIC GOODS**

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**ABSTRACT**

Three essays approach the problem of methods to facilitate cooperation in the provision of public goods by expanding opportunities for reciprocity using the traditional voluntary contributions mechanism (VCM). In the first two essays, mechanisms that allow subjects to sanction or reward other group members are studied. The third essay examines how the opportunity to make binding cooperative commitments affects behavior in the VCM.

In the first essay, rewards and sanctions are examined in a one-shot VCM setting that so far has been unexplored in the literature. The research finds that while some subjects are willing to reward and sanction others at a personal cost, the opportunity to reward or sanction is ineffective in facilitating cooperation relative to previous experiments in which a repeated game environment is employed. The essay also compares behavior in decision situations in which the imposition of rewards and sanctions is certain to decision situations in which imposition is uncertain. Uncertainty does not change behavior in a significant way, either in the level of cooperation or the willingness of individuals to impose rewards or sanctions.

The second essay expands on the first essay by examining rewards and sanctions that vary in relative size in relation to the cost of their imposition. Each type of reward or sanction is examined in a one-shot voluntary contribution mechanism setting. In every environment, some subjects are willing to reward or sanction other subjects at a personal cost. Evidence is found that contributions are significantly

increased in the environment in which the cost of sanctioning is the least relative to the size of the sanction.

Finally, the third essay examines the effect of allowing binding multi-round commitments to the group account in a repeated voluntary contributions mechanism game. Subjects are found to make commitments averaging between 25% and 35% of their endowments. However, total group-account allocations are not systematically greater on average in the commitment experiments than in otherwise identical control experiments without commitments. Further analysis reveals that subjects respond to commitments in a reciprocal manner, and that the variance of outcomes across groups is larger in the commitment experiments than the control experiments.

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## Table of Contents

### Chapter 1

<i>Introduction</i> .....	1
---------------------------	---

### Chapter 2

<i>Rewards and Sanctions and the Provision of Public Goods in One-Shot Settings</i> .....	5
---	---

1. Introduction.....	5
2. Experimental Design.....	5
3. Predictions.....	7
4. Results.....	11
5. Conclusions.....	12

Tables.....	19
Figures.....	21
Appendices.....	25

### Chapter 3

<i>Comparing Rewards and Sanctions of Differing Size in a One-Shot Public Goods Setting</i> .....	52
---	----

1. Introduction.....	52
2. Experimental Design.....	53
3. Predictions.....	57
4. Results.....	58
5. Conclusions.....	65

Tables.....	66
Figures.....	70
Appendices.....	74

### Chapter 4

<i>The Voluntary Provision of a Public Good with Binding Multi-Round Commitments</i> .....	99
--	----

1. Introduction.....	99
2. Previous Experimental Research.....	100
3. Experimental Design.....	103

4. Conjecture.....	105
5. Results.....	108
6. Conclusions.....	117
Tables.....	119
Figures.....	123
Appendices.....	129

## Chapter 5

<i>Concluding Remarks</i> .....	143
---------------------------------	-----

<i>Bibliography</i> .....	146
---------------------------	-----

## **CHAPTER 1**

### **Introduction**

This dissertation focuses on experiments using the traditional voluntary contribution mechanism with a linear group account earning function. In the traditional VCM, subjects are placed in a group, and each receives an identical individual endowment of tokens. Each subject then simultaneously chooses what percentage of his or her endowment to place in the group account and what percentage to retain in his or her private account. A token placed in the group account gives a positive return to each group member. A token placed in a subject's private account gives a positive return solely to that subject. In the most commonly studied form of the VCM the return from the group account and the return from the private account are symmetric across individuals, and are structured so that the group optimum is for all tokens to be allocated to the group account. At the same time, if subjects' preferences are based solely on monetary returns, the dominant strategy for any individual is to place all their tokens in their private account.

The stylized facts emerging from this type of experiment are that contributions to the group account exceed the standard economic prediction of zero tokens, but are substantially below the welfare maximizing level of 100% percent contributions. Initially, contributions to the group account tend to average close to 50% of the endowment. However, there is considerable heterogeneity across individuals in their choice of contributions. Further, when the baseline VCM setting is repeated, average contributions tend to diminish. (see Ledyard, 1995, for a survey.)

Because outcomes in the VCM have tended to be suboptimal, researchers have begun to investigate ways in which cooperation may be better established and maintained. This dissertation focuses on two aspects of this expanding research. Chapters 2 and 3 examine the effect of allowing the sanctioning or rewarding of others in a one-shot (non-repeating) setting that so far has been unexplored in the literature. Chapter 4 examines the effect of "commitment" in the traditional VCM. Experiments are presented in which subjects are permitted to make binding multi-round commitments within a repeated VCM. Finally, chapter 5 contains concluding remarks.

Each essay in this dissertation adds a layer to the traditional VCM that can magnify the effect of orientations toward reciprocity. In the research discussed in chapters 2 and 3, subjects can use reward and sanctioning abilities to reciprocate the behavior of other subjects in a more substantial way than is possible in a regular VCM. While, the commitment opportunities discussed in the 4th chapter allow further opportunities for reciprocity by making information about other subjects' behavior more available, and therefore making the possibility of being exploited by "free riders" less.

In chapter 2, rewards and sanctions are examined in a one-shot VCM setting. Previous experiments examining opportunities to reward and sanction in VCM experiments have shown that significant increases in cooperation can be established in such environments, see Fehr and Gächter (2000), and Sefton Shupp and Walker (2001). In the one-shot experiment presented in chapter 2, a significant number of subjects are found to be willing to reward or sanction others at a personal cost even

with no expectation of repeated interaction. However, the opportunity to reward or sanction is ineffective at facilitating cooperation relative to the previous mentioned studies in which a repeated game environment is employed. Chapter 2 also compares behavior in an environment in which the imposition of rewards and sanctions is certain to an environment in which imposition is uncertain. The expected value of the reward or sanction is kept constant across environments to focus simply on the effect of uncertainty about imposition. Uncertainty does not change behavior in a significant way, either in the level of cooperation or the willingness of individuals to impose rewards or sanctions.

Chapter 3 presents an experiment using the same one-shot setting of chapter 2. Chapter 2 revealed that sanctioning and rewarding opportunities are ineffective in facilitating cooperation in a one-shot VCM setting. The experiment of chapter 3 was designed to examine whether this result may have been due to the fact that the sanction or reward a subject could expect to receive may have been too small to influence VCM behavior. The results of the chapter 3 environments that replicate the chapter 2 experiment are consistent with the results presented in chapter 2. The chapter 3 experiment includes environments in which the size of the reward or sanction a subject can impose is doubled relative to the cost of imposition. No strong evidence exists that expanding the opportunity to reward increases group cooperation in a one-shot VCM setting. However, cooperation within the VCM is significantly expanded in the environment in which opportunities to sanction are expanded. This indicates that at least some additional cooperation can be encouraged by sanctioning opportunities within a one-shot VCM setting.

Chapter 4 approaches the effect of "commitment" within the VCM. The chapter examines the effect of allowing binding multi-round commitments of tokens to the group account in a repeated voluntary contributions mechanism. Before each five-round interval, subjects in a four-person group are given the option to commit a certain percentage of their token endowments to the group account over each of the next five rounds. The total amount of tokens committed by the group is then made public to the group. Each VCM round proceeds normally after commitments are made with each subject's commitment acting as the binding minimum of his or her group account allocation for that round. Subjects have the option of increasing their group allocation above their commitment within each round. The results of the commitment experiment are compared to the results of an otherwise identical VCM control experiment without commitments. Subjects are willing to make binding commitments averaging between  $1/4$  and  $1/3$  of their token endowments for each round. However, total group account allocations are not systematically greater on average in the binding commitment experiments than those observed in the control experiments. Further analysis reveals that subjects respond to commitments in a reciprocal manner, and the variance of outcomes across groups is larger in the commitment experiments than the control experiments.

## CHAPTER 2

### **Rewards and Sanctions and the Provision of Public Goods in One-Shot Settings**

#### **1. Introduction**

As discussed in the introduction, because outcomes in the VCM tend to be sub-optimal, researchers have begun investigated ways in which cooperation may be established and maintained with opportunities to reward or sanction. Ostrom, Walker and Gardner (1992) investigate the maintenance of cooperative decisions in a related dilemma game, and find that "covenants" or promises about future actions can be useful in maintaining cooperation, even when the promises are non-binding. They also find that cooperative agreements made verbally and supported by internal monetary sanctions, i.e. those imposed freely by group members, are even more powerful. On the other hand, they observe that the opportunity to sanction independent of verbal agreements to cooperate can actually lower group welfare, when the costs associated with sanctioning are taken into account.

Gächter and Fehr (2001) study sanctions within the VCM framework. They investigate a 2-stage 'punishment game'. The first stage corresponds to a single period of the voluntary contributions mechanism outlined above. In the second stage all individual contributions are revealed to the group and subjects have an opportunity to sanction each other. Punishment is costly, both to the person punishing and the person being punished. Contributions are significantly higher in the punishment game than in the VCM. Notably, punishment opportunities are exercised in the Fehr and Gächter experiment, thus the increase in contributions overstates the welfare effect of sanctions - one must also account for the costs of punishment. Once this is

done the implications are ambiguous, and more in line with those observed by Ostrom, Walker, and Gardner (1992).<sup>1</sup>

Sefton, Shupp, and Walker (2001) extend the literature on reciprocation opportunities by allowing for rewards as well as sanctions. The structure of the Sefton, Shupp, and Walker experiment is similar to that of Fehr and Gächter except it also includes a 'rewarding game' in which subjects distribute rewards in the second stage instead of sanctions. The sanctioning treatments in Sefton, Shupp, and Walker yield results consistent with Fehr and Gächter. In the treatments that allow rewarding, they find that group account allocations increase, but subjects are better able to sustain contributions in the treatments that allow sanctioning.

This chapter extends the literature on rewards and sanctions by examining them in strictly one-shot environments. In all of the previously cited studies, the game is repeated which means that it is possible for behavior in one round of the experiment to be dependent upon behavior in other rounds of the experiment. Subjects may use rewards and sanctions to influence the behavior of others in future rounds, and not solely to reward or sanction them for their behavior in the current round. Fehr and Gächter (2001) deal with this problem indirectly by examining a "stranger" treatment in which subjects are randomly regrouped after each round of the experiment. But, even in that case, a subject that has observed the sanctioning behavior of others may be influenced in future rounds even if he or she will not encounter the same group members again. Within the one-shot setting investigated

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<sup>1</sup> Masclet et al. (2003) replicates the Fehr and Gächter (2001) experiment with similar results. They also add a treatment in which subjects can display displeasure with other subjects but cannot monetarily punish them. They find that this form of non-monetary punishment increases group account allocations, but not as effectively as monetary punishment.

here, several questions are addressed. To what extent is cooperative behavior within the VCM increased when subjects can impose rewards and sanctions on other group members if there is no expectation of repeated interaction? Secondly, to what extent are subjects willing to reward and sanction others at a personal cost when they cannot expect to receive any benefit in the form of increased cooperation in future rounds?

This chapter also introduces and examines within a one-shot environment the possibility that the imposition of a sanction or reward on the intended recipient may be uncertain. For example, such a case may arise in certain team production environments in which there is uncertainty about whether a supervisor will be willing or able to enforce a sanction on a team member when informed of shirking. This chapter allows comparisons between behavior in environments in which the imposition of a reward or sanction is uncertain to environments in which imposition of rewards and sanctions is certain.

The chapter is organized as follows. The next section describes the experimental setting that is investigated. Section 3 provides predictions based on available theory. Section 4 presents the experimental results. Finally, section 5 contains concluding remarks.<sup>2</sup>

## **2. Experimental Design**

The experiment consisted of four sessions conducted in September and October 2001. Twelve subjects recruited from introductory economics classes at Indiana University - Bloomington participated in each session.<sup>3</sup> The sessions took

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<sup>2</sup> The research discussed in this chapter was published in Halloran and Walker (2004).

<sup>3</sup> A replicative experiment using experienced subjects was performed using 12 subjects drawn randomly from the original 48 subjects. The results of the experiment are largely consistent with the results of the experiments referenced in the chapter, and are not included.

place in classrooms on campus. Each session was conducted on paper with calculations being performed by the experimenters on computer terminals. At the start of each session, subjects were presented with a packet that included initial instructions, separate instructions and decision sheets for each of five decision situations, and finally a questionnaire concerning general information about the subjects and the motivation of their decisions.<sup>4</sup>

The initial instructions informed the subjects of the general structure of the decision situations, and the following introductory information. The subjects were informed that they would make choices in five separate decision situations, but only be compensated based on the outcome of one of the decision situations to be chosen randomly at the end of the experiment.<sup>5</sup> They were also informed that they would be randomly assigned to a four-person group in each of the five decision situations. Finally, they were informed that in all but the first decision situation, there would be two stages. Importantly, they were made aware that they would make their first stage decision in each decision situation and then the decision sheets would be collected and prepared for them to then make their second stage decisions in each decision situation. The instructions were public. The experimenter reviewed the initial instructions with the subjects, and each decision situation as the decision situations progressed.

In the first stage of each of the five decision situations, the subjects participated in a VCM structured in the following way. Each subject was endowed with 10 "blue" tokens to be allocated between their private account and the group

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<sup>4</sup> The instructions and decision sheets given to each subject are presented in this chapter's Appendix A.

<sup>5</sup> At the end of the experiment, a card was drawn from a set of five to determine which of the five decision situations would be used to determine earnings.

account.<sup>6</sup> For each blue token placed in his or her private account a subject received \$1. For each blue token placed in the group account, each group member received 50 cents, a total of \$2.00 for the 4-person group.

Four of the five decision situations had a second stage. In the *baseline VCM* decision situation, there was no second stage. In the other four decision situations subjects were informed of the aggregate allocation to the group account in the first stage, the allocation of each individual to the group account in the first stage, and their own first stage earnings.<sup>7</sup> Subjects then participated in a second stage in which each was endowed with 10 "green" tokens that could be used to reward or sanction the other subjects in their group based upon their first stage decisions.<sup>8</sup> In the *certain reward* decision situation, a green token could be used to increase the earnings of another group member by 20 cents. In the *certain sanction* decision situation, a green token could be used to lower the earnings of another group member by 20 cents. In the *uncertain reward* decision situation, a green token could be used to increase the earnings of another group member but with uncertain results. A green token had a 50% chance of increasing the other group member's earnings by 40 cents, and a 50% chance of leaving the earnings of the other group member unchanged. In the *uncertain sanction* decision situation, the uncertainty took a similar form. A green token had a 50% chance of lowering another group member's earnings by 40 cents, and a 50% chance of leaving the other group members earnings unchanged. Notice

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<sup>6</sup> The tokens were referred to as "blue" in the instructions to distinguish them from the "green" tokens that would be used for sanctioning and reward opportunities.

<sup>7</sup> Individual decisions were not linked to subject identifiers, subjects were never aware of the identities of the other members of their group.

<sup>8</sup> In the instructions, the words "reward" and "sanction" were never used. The instructions referred to opportunities to increase or decrease the earnings of other group members.

that the expected value of rewards and sanctions is kept constant across decision situations to focus solely on the effects of uncertainty.

In each decision situation, any green token not used to reward or sanction another group member was placed in a subject's private account where it earned 20 cents. The subjects could use any number of green tokens to change another subject's earnings, the only rule being that the total number of green tokens they used to change the earnings of their other three group members summed to 10 or less. In the sanctioning situations this implies a sanction reduces both the earnings of the subject imposing the sanction and the subject being sanctioned. Rewards however, take a different form. In the certain environment, they constitute a zero-sum transfer of earnings from the subject giving the reward to the subject receiving it. In the uncertain environment, they represent a zero-sum transfer only in the expected value sense.

The order of the decision situations was different in the final two sessions as opposed to the first two sessions. Table 1 summarizes design information. The decision situations were not referred to by name; they were called decision situation 1, decision situation 2, etc. At the end of the experiment, subjects privately received their earnings which included a \$5 participation fee, their earnings from the one decision situation that was randomly selected, and a further \$2 fee for completing the end of experiment questionnaire.

An important point about the previously described experimental structure deserves special mention. The structure was intentionally chosen to keep each

decision situation as independent from the other decision situations as possible.<sup>9</sup> Subjects were randomly placed in a different 4-person group for each decision situation. Also, all first stage VCM decisions in each of the five decision situations were made before any second stage sanctioning or rewarding opportunities. Finally, individuals never observed the sanctioning and rewarding behavior of other subjects.<sup>10</sup>

### 3. Predictions

If one assumes that subjects make decisions to maximize own earnings, the Nash equilibrium of the *Baseline VCM* decision situation is for all group account allocations to equal zero. In the decision situations that allow rewards or sanctions, the equilibrium predictions are also straightforward. In every case it cannot be equilibrium behavior to sanction or reward another group member if one is maximizing own earnings. Subjects will never sanction or reward because doing so lowers own earnings. Further, subjects playing the first stage VCM can expect to not be sanctioned or rewarded in the second stage, and will therefore choose a group account allocation of zero. Therefore, the unique subgame perfect equilibria of the decision situations that allow rewards and sanctions involve zero allocations to the group account without any use of sanctions or rewards.

However, as noted in the introduction, behavior in VCM studies has not conformed to the previously discussed prediction of zero group account allocations.

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<sup>9</sup> The one case in which behavior in one decision situation could be influenced by behavior in other decision situations is in the second stage reward or sanction choices made in the final four decision situations. For example, strong free riding behavior encountered in one decision situation may make a person more willing to reward cooperative behavior in another decision situation.

<sup>10</sup> The experimental data is presented in this chapter's appendix B.

Contributions tend to be non-zero. Newer modeling approaches have turned to more complicated representations of subject preferences beyond simple maximization of own earnings. For example, subjects may be altruistic as in Andreoni (1988), or subjects may receive utility from reciprocating the behavior of others as in Falk and Fischbacher (2000). Within a VCM game a subject can be altruistic or practice reciprocity by adjusting his or her group account allocation. But, opportunities to reward and sanction allow reciprocation to be targeted toward individuals.

## 4. Results

### 4.1 Group Account Allocations

Table 2 reports the average allocation by individuals to the group account in each of the decision situations. Figure 1 displays the cumulative distributions of individual group account allocations in each of the five decision situations.

**Result 1.** Behavior in the *baseline VCM* decision situation is consistent with other studies. Subjects, on average, allocate about half of their endowment to the group account.

As shown in Table 2, subjects allocate 53.33% of their tokens to the group account on average. This is consistent with first round behavior in repeated game studies that share a marginal per-capita return from the group account of 0.5.<sup>11</sup> There is considerable variation in individual behavior. However, the most common behavior is either for individuals to place their entire endowment in the group account, 27.08% of subjects (the Pareto efficient result), or to contribute no tokens to the group account and retain their endowments in their private account, 29.17% of subjects (the Nash equilibrium result).

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<sup>11</sup> In Sefton, Shupp, and Walker (2001) subjects allocate 53% of their endowment to the group account in the first round. In Swope (2000), they allocate 45%.

**Result 2.** The opportunity to reward other group members, whether the rewards are certain or uncertain, does not have a statistically significant effect on allocations to the group account relative to group account allocations in the *baseline VCM* decision situation.

As shown in Table 2, the mean group allocation in the *baseline VCM* decision situation is greater than or equal to mean group allocations in both the *certain reward* and the *uncertain reward* decision situation. This is true in both orderings of the decision situations, as well as overall. The differences are not statistically significant.<sup>12</sup> As shown in Figure 1, the cumulative distributions of individual group allocations in the *certain reward* and the *uncertain reward* decision situations appear very similar to the cumulative distribution of individual group allocations in the *baseline VCM* decision situation.

**Result 3.** The opportunity to sanction other group members, whether the sanctions are certain or uncertain, does not have a statistically significant effect on allocations to the group account relative to group account allocations in the *baseline VCM* decision situation.

As shown in Table 2, overall mean group account contribution in the *certain sanction* decision situation is slightly smaller than the mean contribution in the *baseline VCM*, while the mean contribution in the *uncertain sanction* decision situation is slightly larger. In both cases, the differences are not statistically significant.<sup>13</sup> As shown in Figure 1, the cumulative distributions of individual group allocations in the *certain sanction* and *uncertain sanction* decision situations appear

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<sup>12</sup> Using the Wilcoxon matched-pairs signed ranks test, the null hypothesis that the distribution of group account allocations is identical in the *baseline VCM* and the *certain reward* decision situations cannot be rejected ( $p = 0.2558$ ). The null hypothesis that the distribution of group allocations is identical in the *baseline VCM* and the *uncertain reward* decision situations also cannot be rejected ( $p = 0.4654$ ).

<sup>13</sup> Using the Wilcoxon matched-pairs signed-ranks test, the null hypothesis that the distribution of group allocations is identical in the *baseline VCM* and the *certain sanction* decision situations cannot be rejected ( $p = 0.7916$ ). The null hypothesis that the distribution of group allocations is identical in the *baseline VCM* and the *uncertain sanction* decision situations also cannot be rejected ( $p = 0.4557$ ).

quite similar to the cumulative distribution of individual group allocations in the *baseline VCM* decision situation.

**Result 4.** Variation in the group account allocations of individual subjects across decision situations is small.

The average standard deviation of group account allocations across the five decision situations for individual subjects is 1.51 tokens. Figure 2 displays the standard deviation of group account allocations in the five decision situations for each subject. More than 73% of subjects have a standard deviation less than 2.<sup>14</sup>

#### *4.2 The Use of Sanctions and Reward*

**Result 5.** Subjects use sanctions and rewards in one-shot environments.

Table 3 displays the average percentage of second stage token endowments that are used to reward or sanction in the four decision situations in which rewarding and sanctioning are possible. In each decision situation, subjects use approximately 20% of their token endowments on average for the purpose of rewarding or sanctioning other subjects in their group. Table 3 also displays the percentage of subjects that use at least one token to reward or sanction other group members in each decision situation. In every decision situation, more than a third of subjects are willing to use at least some of their endowment to reward or sanction other group members.

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<sup>14</sup> A Friedman test provides further evidence for results 2 through 4. The test shows no significant differences across the five decision situations ( $p = 0.7761$ ).

**Result 6.** In the reward decision situations, a subject tends to receive a larger reward the larger is his or her group allocation relative to the average group allocation of other group members.

General support for Result 6 is provided by Figure 3. Figure 3 shows the average number of reward tokens received as a function of an individual's deviation from the average group allocation of other group members for both the *certain reward* and the *uncertain reward* decision situations. In Figure 3 it is apparent that those that make group allocations above the average of other group members receive larger rewards than those that do not. This effect is much more pronounced in the case of the *certain reward* decision situation. In a result that is consistent with Sefton, Shupp and Walker (2001), it is not apparent that large positive deviations from the average are rewarded much more generously than small positive deviations.

Following Fehr and Gächter (2000) and Sefton, Shupp, and Walker (2001), a regression model is estimated to provide more formal evidence of Result 6. A Tobit specification is used with total reward tokens received by a subject as the dependent variable. The independent variables are: 1) the average contribution of other group members, 2) the subject's absolute negative deviation from the average contribution of others, and 3) the subject's absolute positive deviation from the average contribution of others.<sup>15</sup> For Result 6 to hold, a negative deviation should lower one's reward, and a positive deviation should increase one's reward. Table 4 provides results. In both the *certain reward* and *uncertain reward* decision situations, "absolute negative deviation" and "absolute positive deviation" have the expected signs. "Absolute positive deviation" has a negligible marginal effect and is not

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<sup>15</sup> If the average allocation of other group members is  $Xbar$ , and a subject's individual allocation is  $X$ , absolute negative deviation is defined as  $\max \{ 0, Xbar - X \}$  and absolute positive deviation is defined as  $\max \{ 0, X - Xbar \}$ .

statistically significant in the case of the *uncertain reward* decision situation. In both cases "other's average allocation" has a positive sign meaning that groups with a large average group allocation tend to reward more, but "other's average allocation" is not statistically significant in either case.

**Result 7.** In the sanction decision situations, a subject tends to receive a larger sanction the smaller is his or her group allocation relative to the average group allocation of other group members.

Support for Result 7 is provided by Figure 4 and Table 4. Figure 4 shows the number of tokens used to sanction a subject as a function of the subject's deviation from the average contribution of other group members for both the *certain sanction* and the *uncertain sanction* decision situation. Results are similar in both sanctioning situations and in both cases subjects with group allocations below the average allocation of others receive the bulk of the sanctions. Formal evidence for Result 7 is provided by Table 4. A similar regression to that used in the case of rewards is performed for the sanctioning decision situations. In both the *certain sanction* and *uncertain sanction* decision situations "absolute negative deviation" is positive and statistically significant. The regression analysis suggests one interesting difference between the *certain sanction* and *uncertain sanction* decision situations. The marginal effect of "absolute negative deviation" on the size of the sanction a subject receives is more than twice as large in the *uncertain sanction* decision situation.

#### *4.3 Efficiency*

**Result 8.** Allocative efficiency is similar across all decision situations.

Define efficiency as total subject earnings as a percentage of maximum possible subject earnings. Table 5 provides efficiency results for all five decision

situations. It includes efficiency percentages for earnings just from the first stage VCM, and also overall efficiencies for the entire two stage game.<sup>16</sup> The overall efficiencies listed for the *uncertain sanction* and *uncertain reward* decision situations are expected efficiencies based upon all tokens used to sanction or reward having their expected effect.

There is little difference in allocative efficiency across decision situations. The opportunity to reward or sanction does not increase efficiency relative to the *baseline VCM* decision situation. This result is to be expected considering that the opportunity to reward or sanction did little to affect average behavior within the VCM. The overall efficiency level is highest in the *baseline VCM* decision situation (77.37%). Overall efficiency in the *uncertain sanction* decision situation is less than in the *baseline VCM* decision situation even though VCM behavior is slightly more cooperative in the *uncertain sanction* decision situation. This is because of the costs imposed by the use of sanctions.

## **5. Conclusions**

The fundamental difference between this study of this chapter and other VCM studies employing opportunities to reward or sanction is the one shot nature of the decision environment. Previous studies have found that opportunities for rewards or sanctions can lead to more cooperative behavior within the VCM in repeated game environments. This chapter finds that opportunities to reward and sanction in a one-shot environment are not successful in increasing contributions in the VCM, even

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<sup>16</sup> There was no second stage in the *baseline VCM* decision situation. For comparison purposes, the overall efficiency level for the *baseline VCM* decision situation is calculated by assuming that each subject was given the second stage endowment of green tokens.

though subjects do exhibit reciprocal behavior by sanctioning and rewarding other group members in a similar manner to that observed in other studies.<sup>17</sup>

One possible reason for the inability of these reciprocation opportunities to significantly increase contributions is that subjects do not believe it to be credible that others will reward or sanction and therefore they do not change their behavior within the VCM. Another possible reason is that the sanction or reward a subject can expect to receive is too small to influence behavior within the VCM. Chapter 3 examines this question by performing a similar study where the size of rewards and sanctions vary relative to their cost of imposition.

Little evidence is found to indicate that making the imposition of rewards or sanctions uncertain has any consistent implications relative to the case when imposition is certain. Very similar results are found in the *certain reward* and *uncertain reward* decision situations; the same is true in the *certain sanction* and *uncertain sanction* decision situations. In no case is it apparent that the decision rules of subjects are markedly different because of uncertainty in either the reward or the sanction decision situations.

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<sup>17</sup> The opening round in a repeated VCM with rewards or sanctions would be similar to our one-shot environment, in the sense that in the opening round subjects have not been exposed to the second stage reward or sanction response of other subjects. In Sefton, Shupp, and Walker (2001) average individual group account allocations in the opening rounds of treatments that allow sanctions or rewards are not significantly different from average allocations in the same round of the control treatment

## Tables

*Table 1.* Design Information

	Number of Sessions	Subjects per session	Decision Situation 1	Decision Situation 2	Decision Situation 3	Decision Situation 4	Decision Situation 5
First Ordering	2	12	<i>baseline VCM</i>	<i>certain reward</i>	<i>certain sanction</i>	<i>uncertain reward</i>	<i>uncertain sanction</i>
Second Ordering	2	12	<i>baseline VCM</i>	<i>uncertain sanction</i>	<i>uncertain reward</i>	<i>certain sanction</i>	<i>certain reward</i>

*Table 2.* Mean Individual Group Account Allocations

<b>Mean Percentage of Tokens Allocated to Group Account</b>					
	<i>baseline VCM</i>	<i>certain reward</i>	<i>certain sanction</i>	<i>uncertain reward</i>	<i>uncertain sanction</i>
First Ordering	51.67 (41.35)	51.67 (39.74)	55.00 (35.87)	51.25 (39.60)	56.67 (35.10)
Second Ordering	55.00 (39.23)	44.17 (38.89)	49.17 (39.22)	49.17 (38.67)	54.58 (34.26)
<b>Overall</b>	<b>53.33</b> <b>(39.91)</b>	<b>47.91</b> <b>(39.08)</b>	<b>52.08</b> <b>(37.30)</b>	<b>50.21</b> <b>(38.73)</b>	<b>55.63</b> <b>(34.33)</b>

**Note:** Numbers in parentheses are standard deviations.

*Table 3.* Prevalence of Sanctioning and Rewarding behavior

	<b>Tokens Used to Reward or Sanction</b>			
	<i>certain reward</i>	<i>certain sanction</i>	<i>uncertain reward</i>	<i>uncertain sanction</i>
average % of tokens per individual	19.79	20	21.25	20.42
% of individual that use at least one token to sanction or reward	35.41	37.5	43.75	41.57

Table 4. Receipt of Rewards and Sanctions

Dependent Variable: Total Number of Tokens Received to Reward or Sanction

Independent Variables	<i>Certain Reward</i>	<i>Certain Sanction</i>	<i>Uncertain Reward</i>	<i>Uncertain Sanction</i>
Constant	-0.722 (1.044)	-1.656 (0.993)	-0.002 (1.259)	-2.773 (1.349)
Other's Average Allocation	0.192 (0.174)	0.224 (0.160)	0.179 (0.196)	0.118 (0.191)
Absolute Negative Deviation	-0.582** (0.171)	0.428** (0.163)	-0.342* (0.194)	0.932** (0.233)
Absolute Positive Deviation	0.270* (0.146)	0.033 (0.192)	0.130 (0.184)	0.315 (0.227)

Notes: Tobit marginal effects. Standard errors are in parentheses.

\* denotes significance at 10% level, \*\* denotes significance at 5% level

Table 5. Allocative Efficiency

**Total Subject Earnings as a Percentage of Maximum Possible Earnings**

	<i>baseline VCM</i>	<i>certain reward</i>	<i>certain sanction</i>	<i>uncertain reward</i>	<i>uncertain sanction</i>
% of possible earnings from VCM only	76.67	73.96	76.04	75.10	77.81
% of possible earnings from both VCM and reward or sanction stage	78.79	76.33	74.58	77.37	76.12

Note: For the uncertain cases, the second row lists expected efficiencies. The overall efficiencies in the uncertain decision situations could be more or less depending upon the outcomes of the rewards and sanctions in those cases.

## Figures

Figure 1. Cumulate Distributions of Group Allocations in Each Decision Situation.

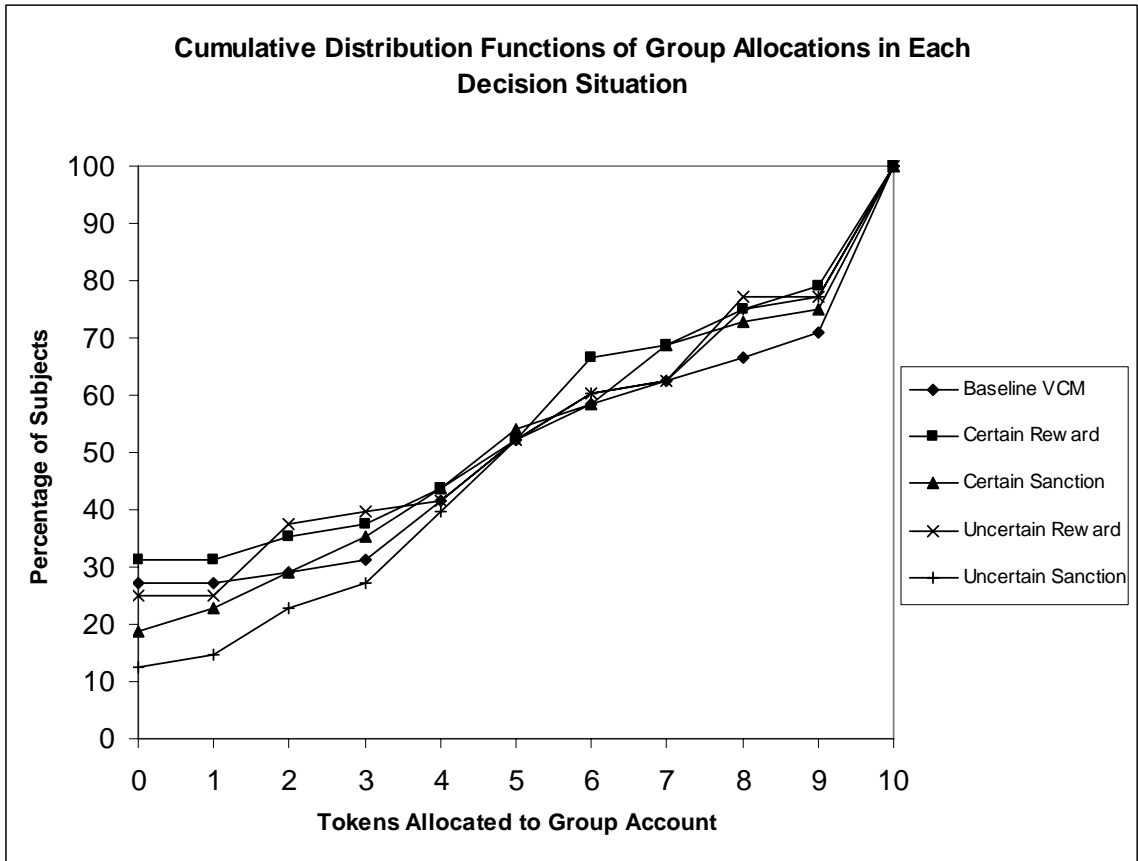
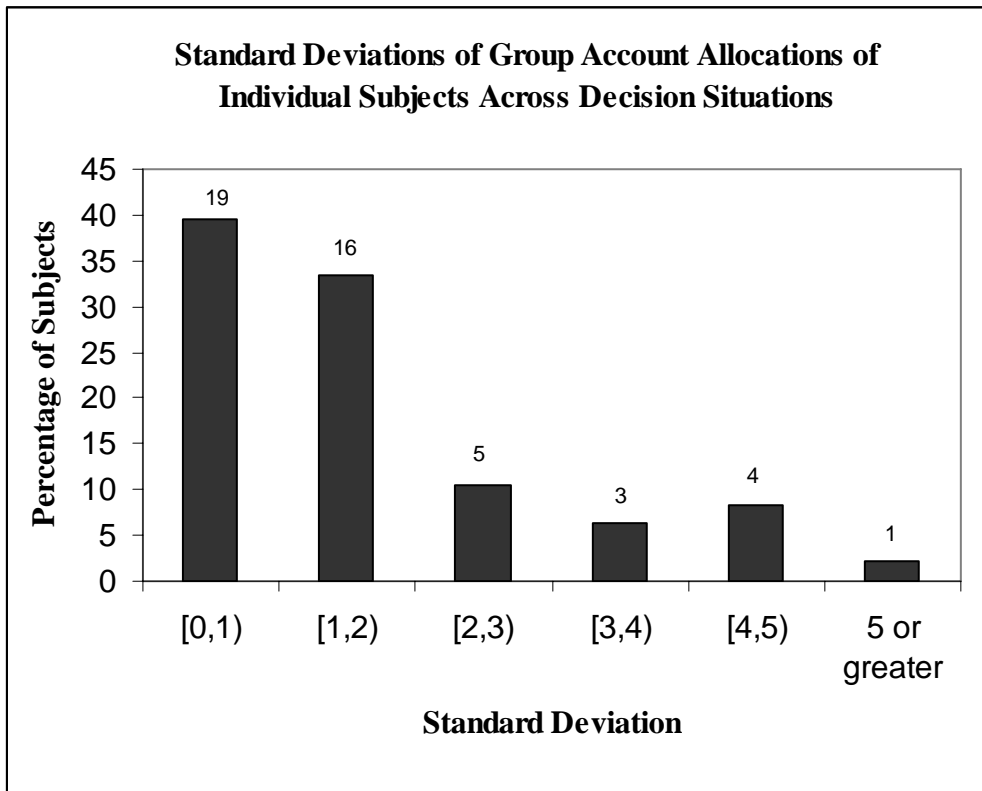
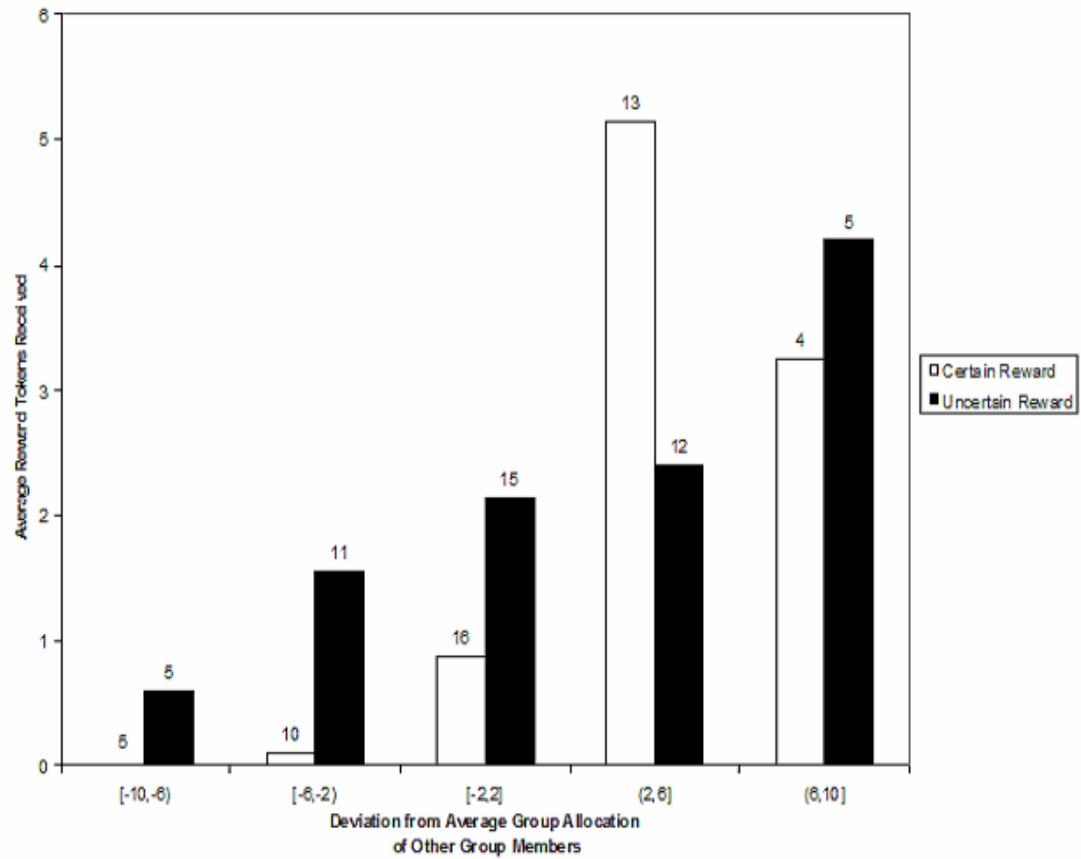


Figure 2. Standard deviations of group account allocations of individual subjects across decision situations



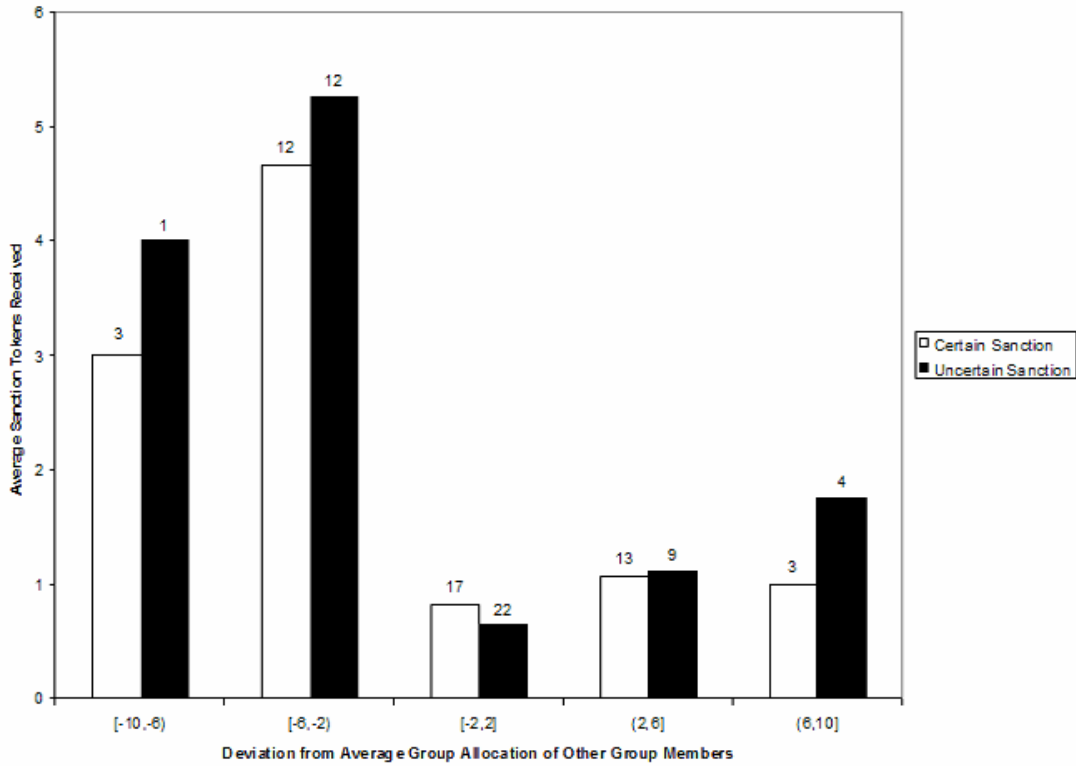
Note: Number on top of bar is the total number of subjects in the interval, there are 48 total subjects.

Figure 3. Reward Tokens Received in Relation to Deviation from Other's Average Group Allocation



Note: Number on top of bar is the total number of subjects in the interval, each decision\_situation has a total of 48 subjects.

Figure 4. Sanction Tokens Received in Relation to Deviation from Other's Average Group Allocation



Note: Number on top of bar is the total number of subjects in the interval, each decision situation has a total of 48 subjects.

## **APPENDIX A - EXPERIMENTAL INSTRUCTIONS**

Presented below are the instructions and decision sheets for the second decision situations ordering of the experiment.

### **Initial Instructions**

In this experiment, you will make choices in five different decision situations. After the experiment is over, we will randomly pick one of the five decision situations for computing earnings.

In each decision situation you will be randomly assigned into a group of four, you and 3 other participants. Therefore, you can expect the composition of your group to be different in each decision situation.

Each decision situation except the first consists of two stages. The first decision situation has no second stage.

First, you will receive instructions for each decision situation separately, and then be given time to make your first stage choices in that situation. After the first stage choices have been made in each decision situation, you will be given time to review and if you wish change any of the first stage choices that you made.

We will then collect the decision sheets and prepare them for you to make your second stage choices in each of the final four decision situations. We will again go through each situation one by one. After the second stage choices have been made, you will be given time to review and if you wish change any of the second stage choices that you made.

After all participants have had time to finalize their decisions, we will collect the decision sheets.

We will randomly pick one of the five decision situations for computing earnings.

Your earnings will depend on your decisions and the decisions of the participants that are in your group for the chosen decision situation.

While we are calculating your earnings, you can earn a further \$2 for completing a short, one page questionnaire.

At the end of the experiment, you will receive your \$5 show-up fee, your earnings from the decision situation that is randomly selected, and your \$2 for completing the questionnaire

*You are participant \_\_\_\_\_ for all decision situations.*

### **Instructions for Decision Situation 1**

The instructions below describe the first decision situation and the way earnings will be determined if this decision situation is the one that is randomly selected.

For this decision situation you will be randomly assigned to a group of size four (you plus three other people).

In this decision situation, you will be endowed with 10 blue tokens. You must choose how many of these blue tokens to allocate to your PRIVATE ACCOUNT and how many blue tokens to allocate to a GROUP ACCOUNT. The amount of money you will earn in this decision situation depends on how many blue tokens you allocate to your private account, how many blue tokens you allocate to the group account, and how many blue tokens the others in your group allocate to the group account.

You can choose any number of blue tokens to allocate to the group account from 0 through 10 blue tokens. The remainder of your blue tokens will be allocated to your private account.

A blue token is worth \$1 when allocated to your private account.

For each blue token you allocate to the group account, you will earn 50 cents, and each of the other three people in your group will also earn 50 cents (a total of \$2 for all four of you together).

Each of the other participants in your group will also be endowed with 10 blue tokens.

For each blue token another person in your group allocates to their private account, they also earn \$1.

For each blue token another person in your group allocates to the group account, this person will earn 50 cents, and each of the other people in the group, you included, will also earn 50 cents (a total of \$2 for the group).

TO SUMMARIZE, in this decision situation you will earn:

\$1 times the number of blue tokens you allocate to your private account PLUS  
\$0.50 times the total number of blue tokens allocated to the group account by  
everyone in the group.

*You are participant \_\_\_\_\_ for all decision situations.*

### **Decision Situation 1 Decision Sheet**

You have been endowed with 10 blue tokens.

In the box below, enter the amount of tokens you wish to allocate to the Group Account. Any remaining tokens will automatically be placed in your Private Account.

How many of your ten blue tokens do you wish to allocate to the group account?

Write a number from 0 to 10 here. \_\_\_\_\_

*You are participant \_\_\_\_\_ for all decision situations.*

## Instructions for Decision Situation 2

The instructions below describe the second decision situation and the way earnings will be determined if this decision situation is the one that is randomly selected.

For this decision situation you will be randomly assigned to a group of size four (you plus three other people).

This decision situation consists of **two stages**. When you have completed the first stage for all five decision situations, we will collect your decision sheets and prepare them for the second stage. They will then be returned to you so that the second stage decisions can be completed.

### The First Stage

In the first stage, the decision you will make is just like the decision you made in Decision Situation 1.

In the first stage you are endowed with 10 blue tokens, and the other three participants in your group are also endowed with 10 blue tokens. You must decide how many of these blue tokens to allocate to the GROUP ACCOUNT, and how many to allocate to your PRIVATE ACCOUNT.

In the first stage you will earn:

\$1 times the number of blue tokens you allocate to your private account PLUS  
\$0.50 times the total number of blue tokens allocated to the group account by  
everyone in the group.

### The Second Stage

On your Decision Situation 2 decision sheet, you will be informed of the total allocation to the group account and your total earnings for the first stage. You will also be informed of the individual group account allocation decisions of the other members of your group. Information about individual choices will be completely anonymous, you will never know the identities of the other members of your group.

In the 2nd stage you are endowed with 10 green tokens. A green token can be allocated to your PRIVATE ACCOUNT, or used to **decrease** the Decision Situation 2 earnings of the other members of your group.

If you allocate a green token to your private account it will increase your Decision Situation 2 earnings by 20 cents.

If you use a green token to decrease the earnings of another group member in this decision situation, it will either decrease that group member's Decision Situation 2 earnings by 40 cents or leave that group member's Decision Situation 2 earnings unchanged. Both of these results are equally likely. For each green token used to decrease another group member's earnings, there will be a separate random draw to determine whether it decreases that group member's earnings by 40 cents, or not at all.

You can choose any number of green tokens to allocate to your private account, from 0 to 10 green tokens, and any number to increase the earnings of each of the other group members, also any number from 0 to 10 green tokens. However, the number of green tokens you allocate to your private account and to increasing the earnings of other group members must sum to 10.

The other three members of your group will also be endowed with 10 green tokens in the second stage, and will be able to use them in the same way.

*You are participant \_\_\_\_\_ for all decision situations.*

**Decision Situation 2 Decision Sheet**

First Stage

In the first stage you have been endowed with 10 blue tokens.

In the box below, enter the amount of blue tokens you wish to allocate to the Group Account. Any remaining blue tokens will automatically be placed in your Private Account.

How many of your ten blue tokens do you wish to allocate to the group account?

Write a number from 0 to 10 here. \_\_\_\_\_

Second Stage

\_\_\_\_\_ blue tokens were allocated to the group account by your group in the first stage.

You earned \_\_\_\_\_ in the first stage.

In this stage you are endowed with 10 green tokens.

The first column of each row below shows how many blue tokens another group member allocated to the Group Account in the first stage. In the column to the right, enter the number of green tokens you wish to use to **decrease** that group member's Decision Situation 2 earnings. You may enter any number from 0 to 10 for each group member below, but all the numbers you enter must add up to 10 OR LESS. Any remaining green tokens will automatically be placed in your Private Account.

<b>Allocations to Group Account by Other Group Members</b>	<b>Number of Green Tokens to Decrease this Member's Earnings</b>
_____	_____
_____	_____
_____	_____

*You are participant \_\_\_\_\_ for all decision situations.*

### Instructions for Decision Situation 3

The instructions below describe the third decision situation and the way earnings will be determined if this decision situation is the one that is randomly selected.

For this decision situation you will be randomly assigned to a group of size four (you plus three other people).

This decision situation consists of **two stages**. When you have completed the first stage for all five decision situations, we will collect your decision sheets and prepare them for the second stage. They will then be returned to you so that the second stage decisions can be completed.

#### The First Stage

In the first stage, the decision you will make is just like the decision you made in Decision Situation 1.

In the first stage you are endowed with 10 blue tokens, and the other three participants in your group are also endowed with 10 blue tokens. You must decide how many of these blue tokens to allocate to the GROUP ACCOUNT, and how many to allocate to your PRIVATE ACCOUNT.

In the first stage you will earn:

\$1 times the number of blue tokens you allocate to your private account PLUS  
\$0.50 times the total number of blue tokens allocated to the group account by  
everyone in the group.

#### The Second Stage

On your Decision Situation 3 decision sheet, you will be informed of the total allocation to the group account and your total earnings for the first stage. You will also be informed of the individual group account allocation decisions of the other members of your group. Information about individual choices will be completely anonymous, you will never know the identities of the other members of your group.

In the 2nd stage you are endowed with 10 green tokens. A green token can be allocated to your PRIVATE ACCOUNT, or used to **increase** the Decision Situation 3 earnings of the other members of your group.

If you allocate a green token to your private account it will increase your Decision Situation 3 earnings by 20 cents.

If you use a green token to increase the earnings of another group member in this decision situation, it will either increase that group member's Decision Situation 3 earnings by 40 cents or leave that group member's Decision Situation 3 earnings unchanged. Both of these results are equally likely. For each green token used to increase another group member's earnings, there will be a separate random draw to determine whether it increases that group member's earnings by 40 cents, or not at all.

You can choose any number of green tokens to allocate to your private account, from 0 to 10 green tokens, and any number to increase the earnings of each of the other group members, also any number from 0 to 10 green tokens. However, the number of green tokens you allocate to your private account and to increasing the earnings of other group members must sum to 10.

The other three members of your group will also be endowed with 10 green tokens in the second stage, and will be able to use them in the same way.

*You are participant \_\_\_\_\_ for all decision situations.*

**Decision Situation 3 Decision Sheet**

First Stage

In the first stage you have been endowed with 10 blue tokens.

In the box below, enter the amount of blue tokens you wish to allocate to the Group Account. Any remaining blue tokens will automatically be placed in your Private Account.

How many of your ten blue tokens do you wish to allocate to the group account?

Write a number from 0 to 10 here. \_\_\_\_\_

Second Stage

\_\_\_\_\_ blue tokens were allocated to the group account by your group in the first stage.

You earned \_\_\_\_\_ in the first stage.

In this stage you are endowed with 10 green tokens.

The first column of each row below shows how many blue tokens another group member allocated to the Group Account in the first stage. In the column to the right, enter the number of green tokens you wish to use to **increase** that group member's Decision Situation 3 earnings. You may enter any number from 0 to 10 for each group member below, but all the numbers you enter must add up to 10 OR LESS. Any remaining green tokens will automatically be placed in your Private Account.

<b>Allocations to Group Account by Other Group Members</b>	<b>Number of Green Tokens to Increase this Member's Earnings</b>
_____	_____
_____	_____
_____	_____

*You are participant \_\_\_\_\_ for all decision situations.*

### Instructions for Decision Situation 4

The instructions below describe the fourth decision situation and the way earnings will be determined if this decision situation is the one that is randomly selected.

For this decision situation you will be randomly assigned to a group of size four (you plus three other people).

This decision situation consists of **two stages**. When you have completed the first stage for all five decision situations, we will collect your decision sheets and prepare them for the second stage. They will then be returned to you so that the second stage decisions can be completed.

#### The First Stage

In the first stage, the decision you will make is just like the decision you made in Decision Situation 1.

In the first stage you are endowed with 10 blue tokens, and the other three participants in your group are also endowed with 10 blue tokens. You must decide how many of these blue tokens to allocate to the GROUP ACCOUNT, and how many allocate to your PRIVATE ACCOUNT.

In the first stage you will earn:

\$1 times the number of blue tokens you allocate to your private account PLUS  
\$0.50 times the total number of blue tokens allocated to the group account by everyone  
in the group.

#### The Second Stage

On your Decision Situation 4 decision sheet, you will be informed of the total allocation to the group account and your total earnings for the first stage. You will also be informed of the individual group account allocation decisions of the other members of your group. Information about individual choices will be completely anonymous, you will never know the identities of the other members of your group.

In the 2nd stage you are endowed with 10 green tokens. A green token can be allocated to your PRIVATE ACCOUNT, or used to **decrease** the Decision Situation 4 earnings of the other members of your group.

If you allocate a green token to your private account it will increase your Decision Situation 4 earnings by 20 cents.

If you use a green token to decrease the earnings of another group member in this decision situation, it will decrease that member's Decision Situation 4 earnings by 20 cents.

You can choose any number of green tokens to allocate to your private account, from 0 to 10 green tokens, and any number to decrease the earnings of each of the other group members, also any number from 0 to 10 green tokens. However, the number of green tokens you allocate to your private account and to decreasing the earnings of other group members must sum to 10.

The other three members of your group will also be endowed with 10 green tokens in the second stage, and will be able to use them in the same way.

*You are participant \_\_\_\_\_ for all decision situations.*

**Decision Situation 4 Decision Sheet**

First Stage

In the first stage you have been endowed with 10 blue tokens.

In the box below, enter the amount of blue tokens you wish to allocate to the Group Account. Any remaining blue tokens will automatically be placed in your Private Account.

How many of your ten blue tokens do you wish to allocate to the group account?

Write a number from 0 to 10 here. \_\_\_\_\_

Second Stage

\_\_\_\_\_ blue tokens were allocated to the group account by your group in the first stage.

You earned \_\_\_\_\_ in the first stage.

In this stage you are endowed with 10 green tokens.

The first column of each row below shows how many blue tokens another group member allocated to the Group Account in the first stage. In the column to the right, enter the number of green tokens you wish to use to **decrease** that group member's Decision Situation 4 earnings. You may enter any number from 0 to 10 for each group member below, but all the numbers you enter must add up to 10 OR LESS. Any remaining green tokens will automatically be placed in your Private Account.

<b>Allocations to Group Account by Other Group Members</b>	<b>Number of Tokens to Decrease this Member's Earnings</b>
_____	_____
_____	_____
_____	_____

*You are participant \_\_\_\_\_ for all decision situations.*

### Instructions for Decision Situation 5

The instructions below describe the fifth decision situation and the way earnings will be determined if this decision situation is the one that is randomly selected.

For this decision situation you will be randomly assigned to a group of size four (you plus three other people).

This decision situation consists of **two stages**. When you have completed the first stage for all five decision situations, we will collect your decision sheets and prepare them for the second stage. They will then be returned to you so that the second stage decisions can be completed.

#### The First Stage

In the first stage, the decision you will make is just like the decision you made in Decision Situation 5.

In the first stage you are endowed with 10 blue tokens, and the other three participants in your group are also endowed with 10 blue tokens. You must decide how many of these blue tokens to allocate to the GROUP ACCOUNT, and how many to allocate to your PRIVATE ACCOUNT.

In the first stage you will earn:

\$1 times the number of blue tokens you allocate to your private account PLUS  
\$0.50 times the total number of blue tokens allocated to the group account by everyone  
in the group.

#### The Second Stage

On your Decision Situation 5 decision sheet, you will be informed of the total allocation to the group account and your total earnings for the first stage. You will also be informed of the individual group account allocation decisions of the other members of your group. Information about individual choices will be completely anonymous, you will never know the identities of the other members of your group.

In the 2nd stage you are endowed with 10 green tokens. A green token can be allocated to your PRIVATE ACCOUNT, or used to **increase** the Decision Situation 5 earnings of the other members of your group.

If you allocate a green token to your private account it will increase your Decision Situation 5 earnings by 20 cents.

If you use a green token to increase the earnings of another group member in this decision situation, it will increase that member's Decision Situation 5 earnings by 20 cents.

You can choose any number of green tokens to allocate to your private account, from 0 to 10 green tokens, and any number to increase the earnings of each of the other group members, also any number from 0 to 10 green tokens. However, the number of green tokens you allocate to your private account and to increasing the earnings of other group members must sum to 10.

The other three members of your group will also be endowed with 10 green tokens in the second stage, and will be able to use them in the same way.

*You are participant \_\_\_\_\_ for all decision situations.*

**Decision Situation 5 Decision Sheet**

First Stage

In the first stage you have been endowed with 10 blue tokens.

In the box below, enter the amount of blue tokens you wish to allocate to the Group Account. Any remaining blue tokens will automatically be placed in your Private Account.

How many of your ten blue tokens do you wish to allocate to the group account?

Write a number from 0 to 10 here. \_\_\_\_\_

Second Stage

\_\_\_\_\_ blue tokens were allocated to the group account by your group in the first stage.

You earned \_\_\_\_\_ in the first stage.

In this stage you are endowed with 10 green tokens.

The first column of each row below shows how many blue tokens another group member allocated to the Group Account in the first stage. In the column to the right, enter the number of green tokens you wish to use to **increase** that group member's Decision Situation 5 earnings. You may enter any number from 0 to 10 for each group member below, but all the numbers you enter must add up to 10 OR LESS. Any remaining green tokens will automatically be placed in your Private Account.

<b>Allocations to Group Account by Other Group Members</b>	<b>Number of Green Tokens to Increase this Member's Earnings</b>
_____	_____
_____	_____
_____	_____

*You are participant \_\_\_\_\_ for all decision situations.*

## CHAPTER 2 - APPENDIX B - EXPERIMENTAL DATA

Four experiments with twelve subjects took place, for a total of 48 subjects. Within each experiment, the twelve subjects were placed into different random 4-person groups for each of the decision situations. All data in terms of "blue" or "green" tokens used.

### 1. Group Account Allocations in Each Decision Situation

		Baseline VCM	Certain Reward	Certain Sanction	Uncertain Reward	Uncertain Sanction
EX 1	Subject 1	10	10	10	10	10
	Subject 2	10	0	2	0	0
	Subject 3	10	9	7	10	8
	Subject 4	0	0	0	0	4
	Subject 5	10	6	7	6	7
	Subject 6	6	6	5	7	4
	Subject 7	5	7	4	6	2
	Subject 8	4	4	7	2	4
	Subject 9	2	3	1	2	1
	Subject 10	0	0	3	2	5
	Subject 11	10	10	10	10	10
	Subject 12	0	0	0	0	0
EX 2	Subject 13	7	8	3	5	5
	Subject 14	6	6	5	8	8
	Subject 15	10	10	10	10	10
	Subject 16	4	10	10	8	8
	Subject 17	6	6	8	5	8
	Subject 18	0	0	7	0	5
	Subject 19	4	5	6	4	6
	Subject 20	0	0	1	0	2
	Subject 21	0	0	0	0	0
	Subject 22	10	10	10	10	10
	Subject 23	10	10	10	10	10
	Subject 24	0	4	6	8	9
EX 3	Subject 25	9	6	5	6	5
	Subject 26	10	10	10	10	10
	Subject 27	5	5	2	6	3
	Subject 28	0	0	0	0	2
	Subject 29	0	0	0	0	0
	Subject 30	10	10	10	10	10
	Subject 31	4	2	4	2	4
	Subject 32	3	0	5	3	2
	Subject 33	5	5	5	5	5
	Subject 34	0	2	3	2	3
	Subject 35	0	0	0	0	0
	Subject 36	8	0	0	0	8

		Baseline VCM	Certain Reward	Certain Sanction	Uncertain Reward	Uncertain Sanction
EX 4	Subject 37	10	10	10	10	10
	Subject 38	4	5	0	2	6
	Subject 39	5	6	4	5	4
	Subject 40	9	8	0	8	0
	Subject 41	8	8	8	8	10
	Subject 42	0	0	4	0	4
	Subject 43	10	0	10	0	10
	Subject 44	7	4	7	5	6
	Subject 45	0	9	9	10	8
	Subject 46	10	6	10	8	6
	Subject 47	10	10	10	10	10
	Subject 48	5	0	2	8	5

## 2. Use of Sanctions and Rewards

### A. Certain Reward Decision Situation

Data is given for the group account allocation of the particular subject, the group account allocations of each of the other group members paired with the subject, the number of tokens used by the subject to reward each other group member, and the number of tokens the subject received in reward from each other group member.

GA : group account allocation of subject

FGM 1 GA: group account allocation of first fellow group member

RG FGM 1: reward tokens used by subject to reward first fellow group member

RR FGM 1: reward tokens used by first fellow group member to reward the subject

FGM 2 GA: group account allocation of second fellow group member

RG FGM 2: reward tokens used by subject to reward second fellow group member

RR FGM 2: reward tokens used by second fellow group member to reward the subject

FGM 3 GA: group account allocation of third fellow group member

RG FGM 3: reward tokens used by subject to reward third fellow group member

RR FGM 3: reward tokens used by third fellow group member to reward the subject

		GA	FGM 1 GA	RG FGM 1	RR FGM 1	FGM 2 GA	RG FGM 2	RR FGM 2	FGM 3 GA	RG FGM 3	RR FGM 3
EX 1	Subject 1	10	7	0	2	9	0	5	0	0	0
	Subject 2	0	7	0	0	9	0	0	10	0	0
	Subject 3	9	7	0	8	0	0	0	10	5	0
	Subject 4	0	6	0	0	6	0	0	0	0	0
	Subject 5	6	6	0	3	0	0	3	0	0	0
	Subject 6	6	6	3	0	0	0	3	0	0	0
	Subject 7	7	9	8	0	0	0	0	10	2	0
	Subject 8	4	10	4	3	0	0	0	3	2	1
	Subject 9	3	10	4	1	0	0	0	4	1	2
	Subject 10	0	6	3	0	6	3	0	0	0	0
	Subject 11	10	0	0	0	4	3	4	3	1	4
	Subject 12	0	10	0	0	4	0	0	3	0	0

		GA	FGM 1 GA	RG FGM 1	RR FGM 1	FGM 2 GA	RG FGM 2	RR FGM 2	FGM 3 GA	RG FGM 3	RR FGM 3
EX 2	Subject 13	8	5	0	0	10	0	0	6	0	0
	Subject 14	6	5	0	0	10	0	0	8	0	0
	Subject 15	10	5	0	0	6	0	0	8	0	0
	Subject 16	10	6	0	4	0	0	0	10	0	5
	Subject 17	6	0	0	0	10	4	0	10	4	0
	Subject 18	0	6	0	0	10	0	0	10	0	0
	Subject 19	5	10	0	0	6	0	0	8	0	0
	Subject 20	0	10	0	0	4	0	0	0	0	0
	Subject 21	0	10	0	0	4	0	0	0	0	0
	Subject 22	10	6	0	4	0	0	0	10	5	0
	Subject 23	10	4	0	0	0	0	0	0	0	0
	Subject 24	4	10	0	0	0	0	0	0	0	0
EX 3	Subject 25	6	2	0	0	5	0	1	10	0	0
	Subject 26	10	2	0	0	5	0	3	6	0	0
	Subject 27	5	2	1	0	10	3	0	6	1	0
	Subject 28	0	0	0	0	10	0	0	2	0	0
	Subject 29	0	10	0	0	2	0	0	0	0	0
	Subject 30	10	0	0	0	2	0	0	0	0	0
	Subject 31	2	5	0	1	10	0	0	6	0	0
	Subject 32	0	0	0	0	0	0	0	5	0	0
	Subject 33	5	0	0	5	0	0	0	0	0	0
	Subject 34	2	0	0	0	10	0	0	0	0	0
	Subject 35	0	0	0	0	0	0	0	5	5	0
	Subject 36	0	0	0	0	0	0	0	5	0	0

		GA	FGM 1 GA	RG FGM 1	RR FGM 1	FGM 2 GA	RG FGM 2	RR FGM 2	FGM 3 GA	RG FGM 3	RR FGM 3
EX 4	Subject 37	10	0	0	0	6	0	4	5	0	1
	Subject 38	5	0	0	0	6	1	1	10	1	0
	Subject 39	6	0	0	0	5	1	1	10	4	0
	Subject 40	8	8	6	0	0	0	0	6	4	3
	Subject 41	8	0	0	0	6	0	4	8	0	6
	Subject 42	0	8	0	0	6	0	0	8	0	0
	Subject 43	0	6	0	0	5	0	0	10	0	0
	Subject 44	4	10	3	0	0	0	0	9	2	0
	Subject 45	9	10	0	0	0	0	2	4	0	2
	Subject 46	6	8	4	0	0	0	0	8	3	4
	Subject 47	10	0	0	2	4	0	3	9	0	0
	Subject 48	0	10	2	0	4	0	0	9	2	0

## B. Certain Sanction Decision Situation

Data is given for the group account allocation of the particular subject, the group account allocations of each of the other group members paired with the subject, the number of tokens used by the subject to sanction each other group member, and the number of tokens the subject received to sanction from each other group member.

GA : group account allocation of subject

FGM 1 GA: group account allocation of first fellow group member

SG FGM 1: sanction tokens used by subject to sanction first fellow group member

SR FGM 1: sanction tokens used by first fellow group member to sanction the subject

FGM 2 GA: group account allocation of second fellow group member

SG FGM 2: sanction tokens used by subject to sanction second fellow group member

SR FGM 2: sanction tokens used by second fellow group member to sanction the subject

FGM 3 GA: group account allocation of third fellow group member

SG FGM 3: sanction tokens used by subject to sanction third fellow group member

SR FGM 3: sanction tokens used by third fellow group member to sanction the subject

		GA	FGM 1 GA	SG FGM 1	SR FGM 1	FGM 2 GA	SG FGM 2	SR FGM 2	FGM 3 GA	SG FGM 3	SR FGM 3
EX 1	Subject 1	10	7	0	0	3	0	0	10	0	0
	Subject 2	2	7	0	0	1	0	1	0	0	0
	Subject 3	7	10	0	0	3	5	2	10	0	0
	Subject 4	0	2	0	0	7	0	0	1	0	0
	Subject 5	7	2	0	0	1	0	1	0	0	0
	Subject 6	5	4	0	1	7	0	0	0	4	0
	Subject 7	4	7	6	1	0	0	0	5	1	0
	Subject 8	7	4	1	6	0	3	0	5	0	0
	Subject 9	1	2	1	0	7	0	0	0	0	0
	Subject 10	3	7	2	5	10	0	0	10	0	0
	Subject 11	10	7	0	0	10	0	0	3	0	0
	Subject 12	0	4	0	0	7	0	3	5	0	4

		GA	FGM 1 GA	SG FGM 1	SR FGM 1	FGM 2 GA	SG FGM 2	SR FGM 2	FGM 3 GA	SG FGM 3	SR FGM 3
EX 2	Subject 13	3	10	0	0	10	0	2	10	0	2
	Subject 14	5	8	0	0	0	5	0	10	0	0
	Subject 15	10	3	0	0	10	0	0	10	0	2
	Subject 16	10	5	0	0	8	0	0	0	0	0
	Subject 17	8	5	0	0	0	0	0	10	0	0
	Subject 18	7	6	0	0	1	5	0	6	0	0
	Subject 19	6	1	0	0	6	0	0	7	0	0
	Subject 20	1	6	0	0	6	0	5	7	0	5
	Subject 21	0	5	0	5	8	0	0	10	0	0
	Subject 22	10	10	0	0	3	2	0	10	0	2
	Subject 23	10	10	2	0	3	2	0	10	2	0
	Subject 24	6	6	0	0	1	5	0	7	0	0
EX 3	Subject 25	5	2	0	2	3	0	0	0	0	0
	Subject 26	10	0	0	0	5	0	0	0	0	0
	Subject 27	2	5	2	0	3	1	0	0	4	0
	Subject 28	0	10	0	0	0	0	0	5	0	0
	Subject 29	0	10	0	0	5	0	0	0	0	0
	Subject 30	10	4	0	0	5	0	0	0	0	0
	Subject 31	4	5	0	0	0	0	0	10	0	0
	Subject 32	5	4	0	0	0	0	0	10	0	0
	Subject 33	5	10	0	0	0	0	0	0	0	0
	Subject 34	3	2	0	1	5	0	0	0	0	0
	Subject 35	0	2	0	4	5	0	0	3	0	0
	Subject 36	0	4	0	0	5	0	0	10	0	0

		GA	FGM 1 GA	SG FGM 1	SR FGM 1	FGM 2 GA	SG FGM 2	SR FGM 2	FGM 3 GA	SG FGM 3	SR FGM 3
EX 4	Subject 37	10	4	0	0	10	0	4	10	0	0
	Subject 38	0	8	0	5	9	0	0	0	4	0
	Subject 39	4	10	0	0	10	0	0	10	0	10
	Subject 40	0	0	0	4	8	2	5	9	3	0
	Subject 41	8	0	5	0	9	0	0	0	5	2
	Subject 42	4	10	0	0	7	0	2	2	0	0
	Subject 43	10	7	0	0	2	0	0	4	0	0
	Subject 44	7	10	0	0	2	4	0	4	2	0
	Subject 45	9	0	0	0	8	0	0	0	0	3
	Subject 46	10	4	0	0	10	4	0	10	4	0
	Subject 47	10	4	10	0	10	0	0	10	0	4
	Subject 48	2	10	0	0	7	0	4	4	0	0

### C. Uncertain Reward Decision Situation

Data is given for the group account allocation of the particular subject, the group account allocations of each of the other group members paired with the subject, the number of tokens used by the subject to reward each other group member, and the number of tokens the subject received in reward from each other group member.

GA : group account allocation of subject

FGM 1 GA: group account allocation of first fellow group member

RG FGM 1: reward tokens used by subject to reward first fellow group member

RR FGM 1: reward tokens used by first fellow group member to reward the subject

FGM 2 GA: group account allocation of second fellow group member

RG FGM 2: reward tokens used by subject to reward second fellow group member

RR FGM 2: reward tokens used by second fellow group member to reward the subject

FGM 3 GA: group account allocation of third fellow group member

RG FGM 3: reward tokens used by subject to reward third fellow group member

RR FGM 3: reward tokens used by third fellow group member to reward the subject

		GA	FGM 1 GA	RG FGM 1	RR FGM 1	FGM 2 GA	RG FGM 2	RR FGM 2	FGM 3 GA	RG FGM 3	RR FGM 3
EX 1	Subject 1	10	0	0	0	2	0	5	7	0	5
	Subject 2	0	10	0	0	2	0	0	7	0	0
	Subject 3	10	0	0	0	6	0	0	0	0	0
	Subject 4	0	0	0	0	6	0	0	10	0	0
	Subject 5	6	0	0	0	0	0	0	10	0	0
	Subject 6	7	0	0	0	10	5	0	2	0	1
	Subject 7	6	2	4	1	2	1	2	10	2	5
	Subject 8	2	2	1	0	6	2	1	10	4	0
	Subject 9	2	2	0	1	6	1	4	10	3	0
	Subject 10	2	0	0	0	10	5	0	7	1	0
	Subject 11	10	2	0	3	2	0	4	6	5	2
	Subject 12	0	6	0	0	0	0	0	10	0	0

		GA	FGM 1 GA	RG FGM 1	RR FGM 1	FGM 2 GA	RG FGM 2	RR FGM 2	FGM 3 GA	RG FGM 3	RR FGM 3
EX 2	Subject 13	5	8	0	2	10	0	0	0	0	0
	Subject 14	8	5	2	0	10	3	0	0	0	0
	Subject 15	10	8	0	4	5	0	3	8	0	2
	Subject 16	8	8	0	0	5	0	1	10	2	0
	Subject 17	5	8	2	0	8	1	0	10	3	0
	Subject 18	0	8	0	0	5	0	0	10	0	0
	Subject 19	4	0	0	0	0	0	0	10	0	2
	Subject 20	0	0	0	0	4	0	0	10	0	4
	Subject 21	0	0	0	0	4	0	0	10	0	4
	Subject 22	10	8	0	3	5	0	0	0	0	0
	Subject 23	10	0	4	0	0	4	0	4	2	0
	Subject 24	8	5	0	2	8	0	0	10	4	0
EX 3	Subject 25	6	10	0	0	2	0	0	10	0	0
	Subject 26	10	6	0	0	2	0	0	10	0	0
	Subject 27	6	0	1	1	0	1	0	0	1	0
	Subject 28	0	0	0	0	0	0	0	6	0	1
	Subject 29	0	0	0	0	0	0	0	6	0	1
	Subject 30	10	10	0	0	6	0	0	2	0	0
	Subject 31	2	5	0	0	3	0	0	0	0	0
	Subject 32	3	5	1	0	2	0	0	0	0	0
	Subject 33	5	3	0	1	2	0	0	0	0	0
	Subject 34	2	10	0	0	6	0	0	10	0	0
	Subject 35	0	5	0	0	3	0	0	2	0	0
	Subject 36	0	0	0	0	0	0	0	6	1	1

		GA	FGM 1 GA	RG FGM 1	RR FGM 1	FGM 2 GA	RG FGM 2	RR FGM 2	FGM 3 GA	RG FGM 3	RR FGM 3
EX 4	Subject 37	10	2	0	2	8	0	0	0	0	0
	Subject 38	2	10	2	0	8	0	1	0	0	0
	Subject 39	5	8	2	0	8	2	0	8	2	2
	Subject 40	8	8	4	0	8	4	0	5	2	2
	Subject 41	8	8	0	0	8	0	4	5	0	2
	Subject 42	0	2	0	0	10	0	0	8	0	3
	Subject 43	0	10	0	0	5	0	0	10	0	0
	Subject 44	5	10	2	0	0	0	0	10	2	0
	Subject 45	10	5	0	2	0	0	0	10	5	5
	Subject 46	8	2	1	0	10	0	0	0	3	0
	Subject 47	10	10	5	5	5	0	2	0	0	0
	Subject 48	8	8	0	0	8	0	4	5	0	2

#### D. Uncertain Sanction Decision Situation

Data is given for the group account allocation of the particular subject, the group account allocations of each of the other group members paired with the subject, the number of tokens used by the subject to sanction each other group member, and the number of tokens the subject received to sanction from each other group member.

GA : group account allocation of subject

FGM 1 GA: group account allocation of first fellow group member

SG FGM 1: sanction tokens used by subject to sanction first fellow group member

SR FGM 1: sanction tokens used by first fellow group member to sanction the subject

FGM 2 GA: group account allocation of second fellow group member

SG FGM 2: sanction tokens used by subject to sanction second fellow group member

SR FGM 2: sanction tokens used by second fellow group member to sanction the subject

FGM 3 GA: group account allocation of third fellow group member

SG FGM 3: sanction tokens used by subject to sanction third fellow group member

SR FGM 3: sanction tokens used by third fellow group member to sanction the subject

		GA	FGM 1 GA	SG FGM 1	SR FGM 1	FGM 2 GA	SG FGM 2	SR FGM 2	FGM 3 GA	SG FGM 3	SR FGM 3
EX 1	Subject 1	10	1	0	0	4	0	0	4	0	0
	Subject 2	0	8	0	10	5	0	10	4	1	0
	Subject 3	8	5	0	0	0	10	0	4	0	0
	Subject 4	4	8	0	0	5	0	0	0	0	0
	Subject 5	7	10	0	0	2	0	3	0	0	0
	Subject 6	4	1	4	0	10	0	0	4	0	0
	Subject 7	2	10	4	0	7	3	0	0	2	0
	Subject 8	4	1	4	0	10	0	0	4	0	0
	Subject 9	1	10	0	0	4	0	4	4	0	4
	Subject 10	5	8	0	0	0	10	0	4	0	0
	Subject 11	10	7	0	0	2	0	4	0	2	0
	Subject 12	0	10	0	2	7	0	0	2	0	2

		GA	FGM 1 GA	SG FGM 1	SR FGM 1	FGM 2 GA	SG FGM 2	SR FGM 2	FGM 3 GA	SG FGM 3	SR FGM 3
EX 2	Subject 13	5	0	1	0	2	0	0	5	0	0
	Subject 14	8	10	3	0	10	4	0	8	3	0
	Subject 15	10	10	0	0	8	0	3	8	0	0
	Subject 16	8	10	0	0	10	0	0	8	0	4
	Subject 17	8	10	0	0	6	0	0	9	0	0
	Subject 18	5	0	5	0	5	0	0	2	0	0
	Subject 19	6	10	0	0	8	0	0	9	0	5
	Subject 20	2	0	1	0	5	0	0	5	0	0
	Subject 21	0	5	0	1	2	0	1	5	0	5
	Subject 22	10	10	0	0	8	0	4	8	0	0
	Subject 23	10	8	0	0	6	0	0	9	0	0
	Subject 24	9	10	0	0	8	0	0	6	5	0
	EX 3	Subject 25	5	5	0	0	2	0	0	10	0
Subject 26		10	3	0	3	3	0	0	2	0	0
Subject 27		3	3	1	0	10	3	0	2	1	0
Subject 28		2	3	0	1	3	0	0	10	0	0
Subject 29		0	0	0	0	4	0	0	8	0	1
Subject 30		10	5	0	0	5	0	0	2	0	0
Subject 31		4	0	0	0	0	0	0	8	0	0
Subject 32		2	5	0	0	5	0	0	10	0	0
Subject 33		5	5	0	0	2	0	0	10	0	0
Subject 34		3	3	0	1	10	0	0	2	0	0
Subject 35		0	0	0	0	4	0	0	8	0	1
Subject 36		8	0	1	0	0	1	0	4	0	0

		GA	FGM 1 GA	SG FGM 1	SR FGM 1	FGM 2 GA	SG FGM 2	SR FGM 2	FGM 3 GA	SG FGM 3	SR FGM 3
EX 4	Subject 37	10	8	0	0	6	0	0	4	0	0
	Subject 38	6	4	1	0	6	1	2	0	4	2
	Subject 39	4	6	0	0	6	0	1	0	0	1
	Subject 40	0	4	1	0	6	2	2	6	2	1
	Subject 41	10	10	0	0	10	0	0	5	2	0
	Subject 42	4	8	0	0	10	0	0	6	0	2
	Subject 43	10	10	0	0	10	0	0	5	0	0
	Subject 44	6	8	0	0	10	0	0	4	2	0
	Subject 45	8	10	0	0	6	0	0	4	0	0
	Subject 46	6	4	0	0	6	2	1	0	2	2
	Subject 47	10	10	0	0	10	0	0	5	10	0
	Subject 48	5	10	0	10	10	0	2	10	0	0

## CHAPTER 3

### **Comparing Rewards and Sanctions of Differing Size in a One-Shot Public Goods Setting**

#### **1. Introduction**

Chapter 2 examined rewards and sanctions in a strictly one-shot setting. This experimental design prevented sanctions and rewards from being used for strategic purposes. In the one-shot setting, the availability of rewards and sanctions simply made reciprocation opportunities more available. Chapter 2 revealed that subjects are willing to reward and sanction other subjects at a personal cost when there is no repeated interaction. However, reward and sanction opportunities did not enhance cooperation in the VCM relative to a one-shot VCM setting in which opportunities to reward or sanction do not exist.

A possible reason that sanctions and rewards were not effective in increasing cooperation in Chapter 2 is that the sanction or reward a subject could expect to receive was too small to influence behavior within the VCM. This chapter attempts to address this question by examining rewards and sanctions that vary in relative size in relation to their cost of imposition. The effect of these rewards and sanctions are examined in the same one-shot setting as Chapter 2

This chapter has many similarities to Gneezy (2003). In that paper, rewards and sanctions of varying size are examined in a one-shot version of the proposer-responder game originally used in Andreoni et. al. (2003). Gneezy finds that opportunities for "small" rewards and sanctions actually tend to lower the amount that the proposer offers a responder. Only when opportunities for "large" rewards and

sanctions are available are offers from the proposer increased relative to a dictator setting.

The experiments in this chapter use a design identical to the experiments in Chapter 2 except the decision situations involving uncertainty are replaced. The experiments of this chapter instead include decision situations in which the effects of rewards or sanctions are increased relative to their cost. The experimental design is presented in the next section. Section 3 provides predictions based on available theory. Section 4 presents the experimental results. Section 5 contains concluding remarks.

## **2. Experimental Design**

The experiment consisted of four sessions conducted in the Spring of 2003. Twelve subjects recruited from introductory economics classes at Indiana University - Bloomington participated in each session. The sessions took place in classrooms on campus. Each session was conducted on paper with calculations being performed by the experimenters on computer terminals. At the start of each session, subjects were presented with a packet that included initial instructions, separate instructions and decision sheets for each of five decision situations, and finally a questionnaire concerning general information about the subjects and the motivation of their decisions.<sup>18</sup>

The initial instructions informed the subjects of the general structure of the decision situations, and the following introductory information. The subjects were informed that they would make choices in five separate decision situations, but only be compensated based on the outcome of one of the decision situations to be chosen

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<sup>18</sup> the instructions and decision sheets of the experiment are included in this chapter's appendix A.

randomly at the end of the experiment.<sup>19</sup> They were also informed that they would be randomly assigned to a four-person group in each of the five decision situations. Finally, they were informed that in all but the first decision situation, there would be two stages. And importantly, they were made aware that they would make their first stage decision in each decision situation and then the decision sheets would be collected and prepared for them to then make their second stage decisions in each decision situation. The instructions were public. The experimenter reviewed the initial instructions with the subjects, and each decision situation as the decision situations progressed.

In the first stage of each of the five decision situations, the subjects participated in a VCM structured in the following way. Each subject was endowed with 10 "blue" tokens to be allocated between his or her private account and the group account.<sup>20</sup> For each blue token placed in his or her private account a subject received \$1. For each blue token placed in the group account, each group member received 50 cents, a total of \$2.00 for the 4-person group.

Four of the five decision situations had a second stage. In the *baseline VCM* decision situation, there was no second stage. In the other four decision situations subjects were informed of the aggregate allocation to the group account in the first stage, the allocation of each individual to the group account in the first stage, and their own first stage earnings.<sup>21</sup> They then participated in a second stage in which

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<sup>18</sup> At the end of the experiment, a card was drawn from a set of five to determine which of the five decision situations would be used to determine earnings.

<sup>19</sup> The tokens were referred to as "blue" in the instructions to distinguish them from the "green" tokens that would be used for sanctioning and reward opportunities.

<sup>20</sup> Individual decisions were not linked to subject identifiers, subjects were never aware of the identities of the other members of their group.

subjects were endowed with 10 "green" tokens that could be used to reward or sanction the other subjects in their group based upon their first stage decisions.<sup>22</sup> In the *low reward* decision situation, a green token could be used to increase the earnings of another group member by 20 cents. In the *low sanction* decision situation, a green token could be used to lower the earnings of another group member by 20 cents.<sup>23</sup> In the *high reward* decision situation, a green token could be used to increase the earnings of another group member by 40 cents. In the *high sanction* decision situation, a green token could be used to decrease the earnings of another group member by 40 cents.

In each decision situation, any green token not used to reward or sanction another group member was placed in a subject's private account where it earned 20 cents. In both the *low reward* and *low sanction* decision situations sanctioning or rewarding another subject requires that a subject incur a monetary cost equal to the size of the reward or sanction imposed on the receiver. In the *high reward* and *high sanction* decision situations, the monetary cost to a subject of rewarding or sanctioning another subject is half as large as the monetary sanction or reward received by the receiver. The subjects could use any number of green tokens to change another subject's earnings, the only rule being that the total number of green tokens they used to change the earnings of their other three group members summed to 10 or less.

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<sup>21</sup> In the instructions, the words "reward" and "sanction" were never used. The instructions referred to opportunities to increase or decrease the earnings of other group members.

<sup>23</sup> The *baseline VCM*, *low reward*, and *low sanction* decision situations are identical to the *baseline VCM*, *certain reward*, and *certain sanction* decision situations in Chapter 2.

This experimental design implies the following about the decision situations that allow opportunities to reward. In the *low reward* decision situation, rewards constitute a zero-sum transfer from the subject giving the reward to the receiver of the reward. In the *high reward* decision situation, the use of rewards is Pareto improving because each green token used to reward another subject increases the earnings of the receiver more than it decreases the earnings of the subject providing the reward. One can view the second stage of the high reward decision situation as a repetition of the VCM environment of the first stage with caveats. In the reward stage of the *high reward* decision situation, using a green token to reward another subject is similar to placing a token in the group account in the first stage except for the fact that the individual return of doing so is zero, and the reward is targeted to a specific group member.

In both the *low sanction* and *high sanction* decision situations sanctioning reduces both the earnings of the subject imposing the sanction and the subject being sanctioned. This implies that the use of sanctions in either case is inefficient from the point of view of total earnings. This is most pronounced in the *high sanction* decision situation because of the magnified effect of sanctioning in that decision situation.

The order of the decision situations was different in the final two sessions as opposed to the first two sessions. Table 6 summarizes design information. The decision situations were not referred to by name; they were called decision situation 1, decision situation 2, etc. At the end of the experiment, subjects privately received their earnings which included a \$5 participation fee, their earnings from the one

decision situation that was randomly selected, and a further \$2 fee for completing the end of experiment questionnaire.

An important point about the previously described experimental structure deserves special mention. The structure was intentionally chosen to keep each decision situation from being linked in any way to the other decision situations. Subjects were randomly placed in a different 4-person group for each decision situation. Also, all first stage VCM decisions in each of the five decision situations were made before any second stage sanctioning or rewarding opportunities. Finally, individuals never observed the sanctioning and rewarding behavior of other subjects.<sup>24</sup>

### **3. Predictions**

If one assumes that subjects make decisions to maximize own earnings, and that subjects expect others to do the same, the Nash equilibrium of the *Baseline VCM* decision situation is for all group account allocations to equal zero. In the decision situations that allow rewards or sanctions, the equilibrium predictions are also straightforward. In every case it cannot be equilibrium behavior to sanction or reward another group member if one is maximizing own earnings. Subjects will never sanction or reward because doing so lowers own earnings. Further, subjects playing the first stage VCM can expect to not be sanctioned or rewarded in the second stage, and will therefore choose a group account allocation of zero. Therefore, the unique subgame perfect equilibria of the decision situations that allow rewards and sanctions involve zero allocations to the group account without any use of sanctions or rewards.

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<sup>24</sup> The experimental data is presented in this chapter's appendix B.

However, as discussed in Chapter 2, outcomes in the VCM often do not conform to the Nash equilibrium prediction based upon own earnings maximization by subjects. Subjects may be oriented toward reciprocity, and be willing to use the opportunity to reward or sanction to reciprocate the behavior of other group members in the first stage VCM. If group members expect to be rewarded or sanctioned for their VCM choices, they may change their behavior so as to influence the sanction or reward they will receive. If this is the case, we can expect VCM behavior to be more cooperative in the *high reward* and *high sanction* decision situations relative to the other 3 decision situations, because the size of the reward or sanction a subject would expect to receive in those decisions situations would be larger relative to the other decision situations for any given level of cooperative or uncooperative VCM behavior.

## 4. Results

### 4.1 Group Account Allocations

**Result 1.** Behavior in the baseline VCM decision situation is largely consistent with behavior in other VCM studies. Subjects, on average, allocate about half of their endowment to the group account.

Table 7 reports mean group allocations in the baseline VCM decision situation. Overall, subjects allocate 5.77, or 57.7% of their tokens to the group account on average. This is generally consistent with other studies that share a marginal per-capita return from the group account of 0.5.<sup>25</sup> For example, in Chapter 2, a study using a structure identical to this one, subjects contributed 53.3% of their tokens to the group account. Figure 5 displays the cumulative distribution of

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<sup>25</sup> In Sefton, Shupp, and Walker (2001) subjects allocate 53% of their endowment to the group account in the first round. In Swope (2000), they allocate 45%.

individual contributions in the *baseline VCM* decision situation. There is a large variation in individual behavior. A third of subjects choose to contribute their entire endowment to the group account, this is the most common individual choice.

**Result 2.** Group account allocations in the *low reward* and the *low sanction* decision situations are not significantly changed relative to group account allocations in the *baseline VCM* decision situation.

Table 7 reports mean group account allocations in the *low reward* and the *low sanction* decision situations. The overall mean group allocation is slightly lower in the *low reward* decision situation than in the *baseline VCM* decision. The overall mean group allocation is slightly higher in the *low sanction* decision situation than in the *baseline VCM* decision situation. Table 8 presents non-parametric matched pairs Mann-Whitney tests comparing group allocations in the *low reward* and *low sanction* decision situations to group allocations in the *baseline VCM* decision situation. In neither case is the difference statistically significant. This result is consistent with the results in Chapter 2.

Figure 5 displays the cumulative distributions of individual group allocations of subjects in the *low reward* and the *low sanction* decision situations. Graphically the distributions are quite similar to the distribution of group allocations in the *baseline VCM* decision situation.

**Result 3.** Group account allocations in the *high reward* decision situation are not significantly increased relative to group account allocations in the *baseline VCM* decision situation.

Table 7 reports mean group account allocations in the *high reward* decision situation. The overall mean group allocation is slightly higher in the *high reward* decision situation than in the *baseline VCM* decision. Table 8 presents a matched pairs Mann-

Whitney test comparing group allocations in the *high reward* decision situations to group allocations in the *baseline VCM* decision situation. The difference is not statistically significant.

Figure 5 displays the cumulative distribution of individual group allocations in the *high reward* decision situation. The distribution is visually very similar to the distribution of individual group allocations in the *baseline VCM* decision situation.

**Result 4.** Group account allocations are significantly increased in the *high sanction* decision situation relative to group account allocations in the *baseline VCM* decision situation.

Table 7 displays mean group allocations in the high sanction decision situation. The mean group allocation in the high sanction decision situation is 0.83 tokens higher than the mean group allocation in the baseline VCM decision situation. This difference is significant at the 5% level according to the matched-pairs Mann-Whitney test shown in Table 8. Figure 5 displays the cumulative distribution of individual group allocations in the *high sanction* decision situation. A larger percentage of subjects have comparatively high group account allocations in the *high sanction* decision situation than in any of the other decision situations.

Further evidence for Result 4 is provided by Table 9 which provides comparisons of individual behavior between the decision situations that allow sanctions or rewards and the *baseline VCM* decision situation. In the *high sanction* decision situation a third of subjects have a group allocation that exceeds their group allocation in the *baseline VCM* decision situation, while only 14.38 percent of subjects have a lower group allocation than in the *baseline VCM*. Also, the subjects that increase their group allocations above their group allocations in the *baseline*

*VCM* tend do so by the greatest amount compared to other decision situations. It appears that the threat of possible sanctions in the *high sanction* decision situation is powerful enough to encourage a large enough number of subjects to adjust their behavior in a more cooperative direction relative to their behavior in the *baseline VCM*. This does not appear to be the case in the *low sanction* decision situation. Similarly, in the decision situations that allow rewards, possible rewards do not appear powerful enough to encourage a sufficient number of subjects to increase their group allocations relative to the *baseline VCM* decision situation.

**Result 5.** Large variations across decisions situations in the group account allocations of individual subjects are rare.

The average standard deviation of group account allocations across the five decision situations for individual subjects is 1.07 tokens. Figure 6 displays the standard deviation of group account allocations in the five decision situations for each subject. More than 72% of subjects have a standard deviation less than 2.

#### *4.2 The Use of Sanctions and Reward*

**Result 6.** Subjects use sanctions and rewards in all four decision situations that allow sanctions or rewards. Rewarding is more common overall than sanctioning. The use of rewards is very pronounced in the *high reward* decision situation.

Table 10 lists the average percentage of second stage token endowments that are used to reward or sanction in the four decision situations in which rewarding and sanctioning are possible. The use of second stage tokens is least prevalent in the *high sanction* decision situation. The use of second stage tokens is most prevalent in the *high reward* decision situation. About one third of second stage token endowments are used to reward in the *high reward* decision situation, and about two thirds of subjects use at least one token to reward other subjects. This indicates that subjects

respond to the Pareto improving nature of the rewards in the *high reward* decision situation.

**Result 7.** In the reward decision situations, a subject tends to receive a larger reward the larger is his or her group allocation relative to the average group allocation of other group members.

General support for Result 7 is provided by Figure 7. Figure 7 shows the average number of reward tokens received as a function of an individual's deviation from the average group allocation of other group members for both the *certain reward* and the *uncertain reward* decision situations. In Figure 7 it is apparent that those that make group allocations above the average of other group members receive larger awards than those that do not. This result is much more pronounced in the *high reward* decision situation.

Just as in Chapter 2, a regression model is estimated to provide more formal evidence of Result 7. A Tobit specification is used with total reward tokens received by a subject as the dependent variable. The independent variables are: 1) the average contribution of other group members, 2) the subject's absolute negative deviation from the average contribution of others, and 3) the subject's absolute positive deviation from the average contribution of others.<sup>26</sup> For Result 7 to hold, a negative deviation should lower one's reward, and a positive deviation should increase one's reward. Table 11 provides results. In both the *low reward* and *high reward* decision situations, "absolute negative deviation" and "absolute positive deviation" have the expected signs. "Absolute positive deviation" is not statistically significant in the case of the *low reward* decision situation. In both cases "other's average allocation"

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<sup>25</sup> If the average allocation of other group members is  $Xbar$ , and a subject's individual allocation is  $X$ , absolute negative deviation is defined as  $\max \{ 0, Xbar - X \}$  and absolute positive deviation is defined as  $\max \{ 0, X - Xbar \}$ .

has a positive sign meaning that groups with a large average group allocation tend to reward more, "other's average allocation" is not statistically significant in the low reward decision situation.

**Result 8.** In the sanction decision situations, a subject tends to receive a larger sanction the smaller is his or her group allocation relative to the average group allocation of other group members.

Support for Result 8 is provided by Figure 8. Figure 8 shows the number of tokens used to sanction a subject as a function of the subject's deviation from the average contribution of other group members for both the *low sanction* and the *high sanction* decision situation. In both cases subjects with group allocations below the average allocation of others receive the majority of the sanctions. A similar regression to that used in the case of rewards is performed for the sanctioning decision situations. As shown in Table 11, in both the *low sanction* and *high sanction* decision situations "absolute negative deviation" is positive and statistically significant.

**Result 9.** In general, subjects tend to reward or sanction others more the higher is their own group account allocation. They tend to reward more the higher is the average contribution of other subjects in there group. They tend sanction more the lower is the average contribution of other subjects.

Table 12 displays the results of Tobit regressions. The dependent variable is the total number of tokens a subject uses to reward or sanction other subjects. The independent variables are: 1) the subjects own group account allocation, and 2) the average group allocation of the other subjects in the subject's group. In all cases, except the *low reward* decision situation, the coefficient on "Own Allocation" is positive meaning that subjects tend to sanction and reward more the higher is their own contribution. The coefficient is only statistically significant in the case of the *low sanction* decision situation. The coefficient on "Other's Average Allocation" has

the expected sign in all cases, it is positive in the reward decision situations, and negative in the sanction decision situations. In no case is "Other's Average Allocation" statistically significant.

#### 4.3 Efficiency

**Result 10.** Overall Efficiency levels are similar across decision situations

Define efficiency as total subject earnings as a percentage of maximum possible subject earnings. Table 13 provides efficiency results for all five decision situations. It includes efficiency percentages for earnings just from the first stage VCM, and also overall efficiencies for the entire two stage game.<sup>27</sup>

The overall efficiency level is higher in the *baseline VCM* decision situation than in either the *low sanction* or the *high sanction* decision situations even though VCM behavior is more cooperative in the sanctioning decision situations. This is because of the costs imposed by the use of sanctions. Anytime a sanction is imposed, efficiency must fall because sanctioning imposes a cost on the subject imposing the sanction, as well on the recipient of the sanction. This is most pronounced in the *high sanction* decision situation because the cost imposed by sanctions is highest in that case. Overall efficiencies are the highest in the high reward decision situation, because of the Pareto improving nature of rewards in that decision situation.<sup>28</sup>

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<sup>26</sup> There was no second stage in the *baseline VCM* decision situation. For comparison purposes, the overall efficiency level for the *baseline VCM* decision situation is calculated by assuming that each subject was given the second stage endowment of green tokens.

<sup>28</sup> In the case of the high reward decision situation maximum possible earnings are assumed not to include the possible earnings that immediately accrue whenever a reward is imposed. If those earnings are included in maximum possible earnings, the two stage efficiency is 78.72%.

## 5. Conclusions

Chapter 2 found that sanctioning and rewarding opportunities are ineffective in facilitating cooperation in a one-shot VCM setting. This chapter was designed to examine whether this result may have been due to the fact that the sanction or reward a subject could expect to receive may have been too small to influence VCM behavior. The results of this chapter are largely consistent with the results of Chapter 2. Results in the *low reward* and *low sanction* decision situations are consistent with results in the identical *certain reward* and *certain sanction* decision situations Chapter 2. There is no evidence that expanding the opportunity to reward as is done in the *high reward* decision situation increases group cooperation relative to the *baseline VCM* decision situation. However, it is interesting that in that decision situation the use of rewards is expanded.

The most interesting result of this chapter is that cooperation within the VCM is expanded in the *high sanction* decision situation. This indicates that at least some additional cooperation can be encouraged by sanctioning opportunities within a one-shot VCM setting. It would be interesting to see the effect of expanding sanctioning opportunities even more relative to their cost of imposition.

## Tables

*Table 6.* Design Information

	Number of Sessions	Subjects per session	Decision Situation 1	Decision Situation 2	Decision Situation 3	Decision Situation 4	Decision Situation 5
First Ordering	2	12	<i>baseline VCM</i>	<i>low reward</i>	<i>low sanction</i>	<i>high reward</i>	<i>high sanction</i>
Second Ordering	2	12	<i>baseline VCM</i>	<i>high sanction</i>	<i>high reward</i>	<i>low sanction</i>	<i>low reward</i>

*Table 7.* Mean Group Account Allocations in First Stage VCM

<b>Mean Allocations to Group Account</b>					
	<i>baseline VCM</i>	<i>low reward</i>	<i>low sanction</i>	<i>high reward</i>	<i>high sanction</i>
First Ordering	5.00 (4.04)	5.04 (3.86)	5.04 (3.71)	5.58 (3.60)	5.88 (3.60)
Second Ordering	6.54 (3.54)	6.21 (4.26)	7.08 (3.42)	6.92 (3.62)	7.33 (3.13)
<b>Overall</b>	5.77 (3.84)	5.63 (4.06)	6.06 (3.68)	6.25 (3.64)	6.60 (3.42)

**Note:** Numbers in parentheses are standard deviations.

*Table 8.* Tests Comparing Mean Group Account Contributions to Mean Group Account Contributions in Baseline VCM Decision Situation.

Mann-Whitney Matched Pairs Test	
	<i>p</i> -value
<i>low reward</i>	0.455
<i>low sanction</i>	0.325
<i>high reward</i>	0.126
<i>high sanction</i>	0.031**

\*\* denotes significance at 95% level.

Table 9. Differences in Individual Group Account Allocation in Relation to Individual Group Allocation in *Baseline VCM* Decision Situation.

	Higher group allocation than baseline VCM (% of subjects)	Average Difference (number of tokens)	Average Contribution in Baseline VCM (number of Tokens)	Lower group allocation than baseline VCM (% of subjects)	Average Difference (number of tokens)	Average Contribution in Baseline VCM (number of tokens)
<i>low reward</i>	18.75	1.89	5.11	25.00	-2.00	5.17
<i>low sanction</i>	37.50	2.17	3.39	22.91	-2.27	5.45
<i>high reward</i>	31.25	2.53	4.00	18.75	-1.66	5.22
<i>high sanction</i>	33.33	3.75	2.69	14.58	-2.86	5.86

	Same group allocation as baseline VCM (% of subjects)	Average Contribution in Baseline VCM (number of tokens)
<i>low reward</i>	56.25	6.26
<i>low sanction</i>	39.58	8.21
<i>high reward</i>	50.00	7.08
<i>high sanction</i>	52.08	7.72

Table 10. Prevalence of Sanctioning and Rewarding behavior

	<b>Tokens Used to Reward or Sanction</b>			
	<i>low reward</i>	<i>low sanction</i>	<i>high reward</i>	<i>high sanction</i>
average % of tokens per individual	22.92	16.04	32.08	14.36
% of individuals that use at least one token to sanction or reward	45.83	37.5	62.50	29.17

Table 11. Receipt of Rewards and Sanctions

Dependent Variable: Tokens Received to Reward or Sanction

Independent Variables	<i>Low Reward</i>	<i>Low Sanction</i>	<i>High Reward</i>	<i>High Sanction</i>
Constant	1.028 (0.872)	-2.380* (1.227)	-0.629 (1.608)	-3.365** (1.709)
Other's Average Allocation	0.109 (0.109)	0.275 (0.178)	0.377* (0.223)	0.230 (0.203)
Absolute Negative Deviation	-0.734*** (0.173)	0.352*** (0.167)	-0.584** (0.198)	0.364** (0.184)
Absolute Positive Deviation	0.175 (0.154)	-0.047 (0.361)	0.969*** (0.178)	0.167 (0.247)

Notes: Tobit marginal effects. Standard errors are in parentheses. \* denotes significance at 10% level, \*\* denotes significance at 5% level, \*\*\* denotes significance at 1% level

Table 12. Determinates of the giving of Rewards and Sanctions

Dependent Variable: Total Number of Tokens Used to Reward or Sanction other Subjects

Independent Variables	<i>Low Reward</i>	<i>Low Sanction</i>	<i>High Reward</i>	<i>High Sanction</i>
Constant	-1.786 (2.316)	-4.403 (3.781)	0.173 (3.149)	-2.715 (4.283)
Own Contribution	-0.039 (0.244)	0.619** (0.270)	0.072 (0.206)	0.123 (0.389)
Other's Average Contribution	0.316 (0.347)	-0.142 (0.457)	0.225 (0.405)	-0.240 (0.557)

Notes: Tobit maximum likelihood estimates. Standard errors are in parentheses. \* denotes significance at 10% level, \*\* denotes significance at 5% level, \*\*\* denotes significance at 1% level

Table 13. Allocative Efficiency

**Total Subject Earnings as a Percentage of Maximum Possible Earnings**

	<i>baseline VCM</i>	<i>low reward</i>	<i>low sanction</i>	<i>high reward</i>	<i>high sanction</i>
% of possible earnings from VCM only	78.85	78.13	80.31	81.25	83.02
% of possible earnings from both VCM and reward or sanction stage	80.78	80.11	79.18	78.72	80.64

Note: In the case of the high reward decision situation maximum possible earnings are calculated assuming that all tokens are used to reward, this increases maximum possible earnings above the other decision situations.

## Figures

Figure 5. Cumulate Distributions of Group Allocations in Each Decision Situation.

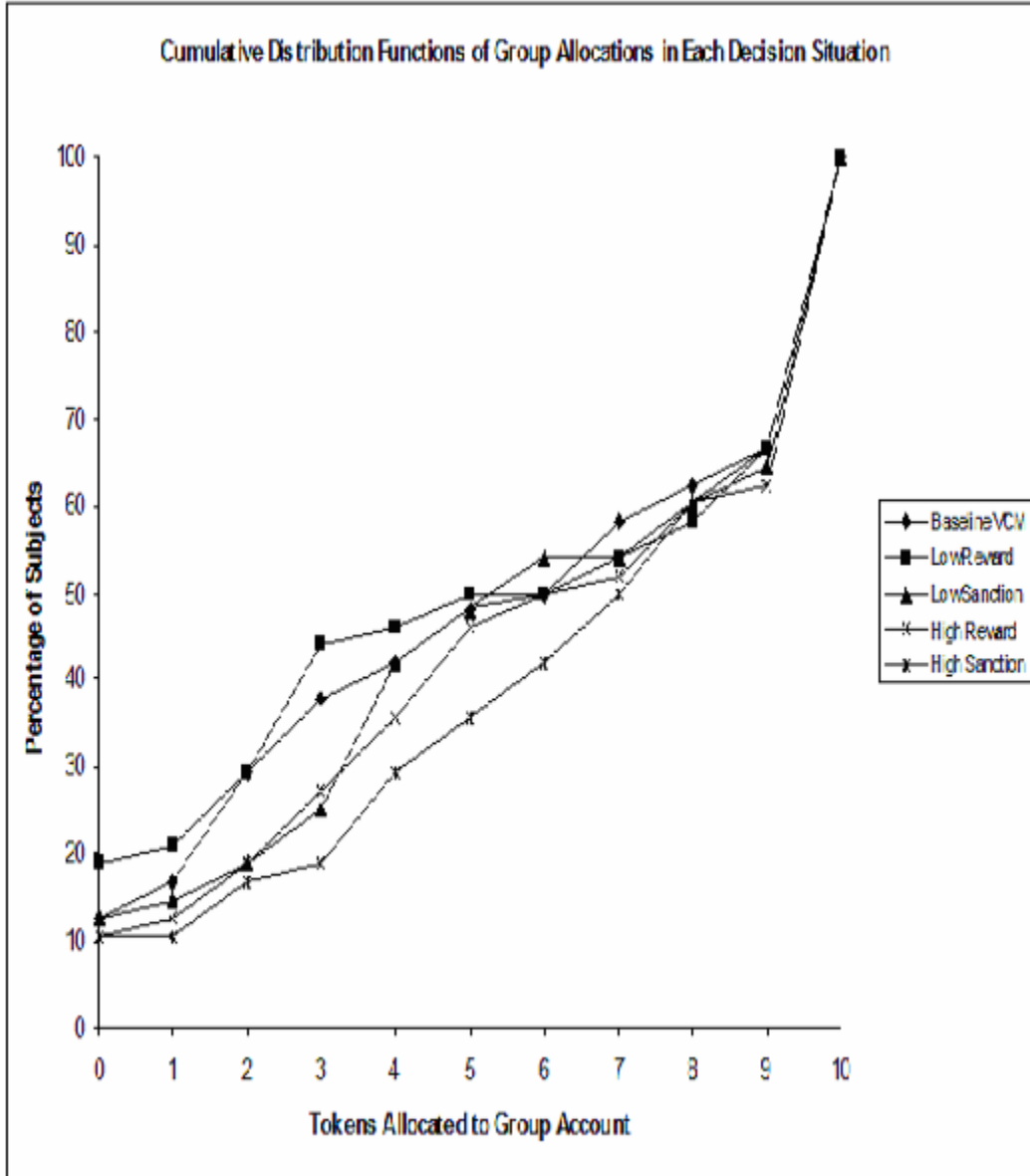
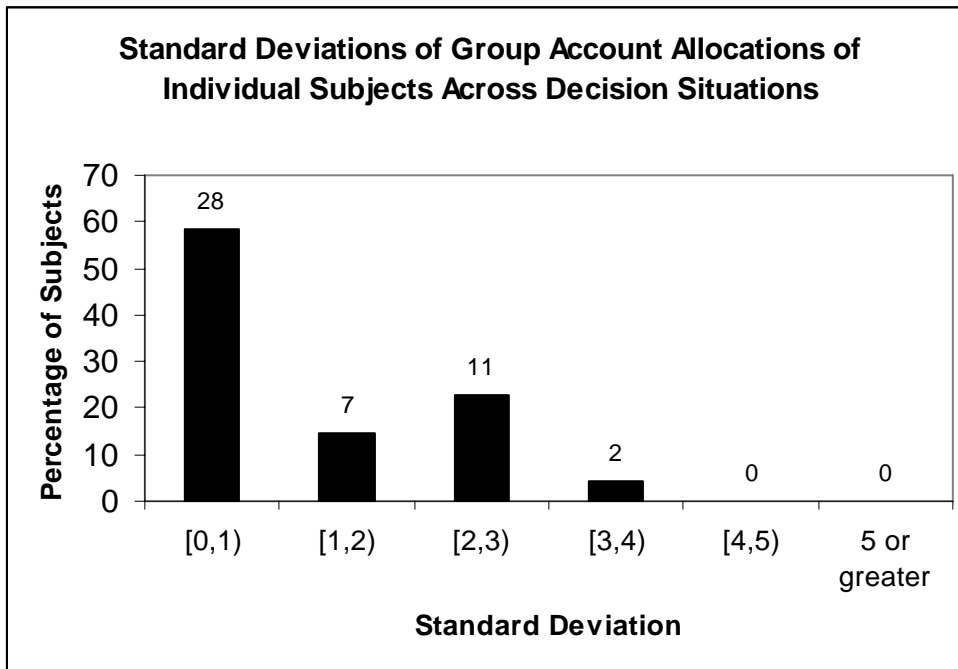
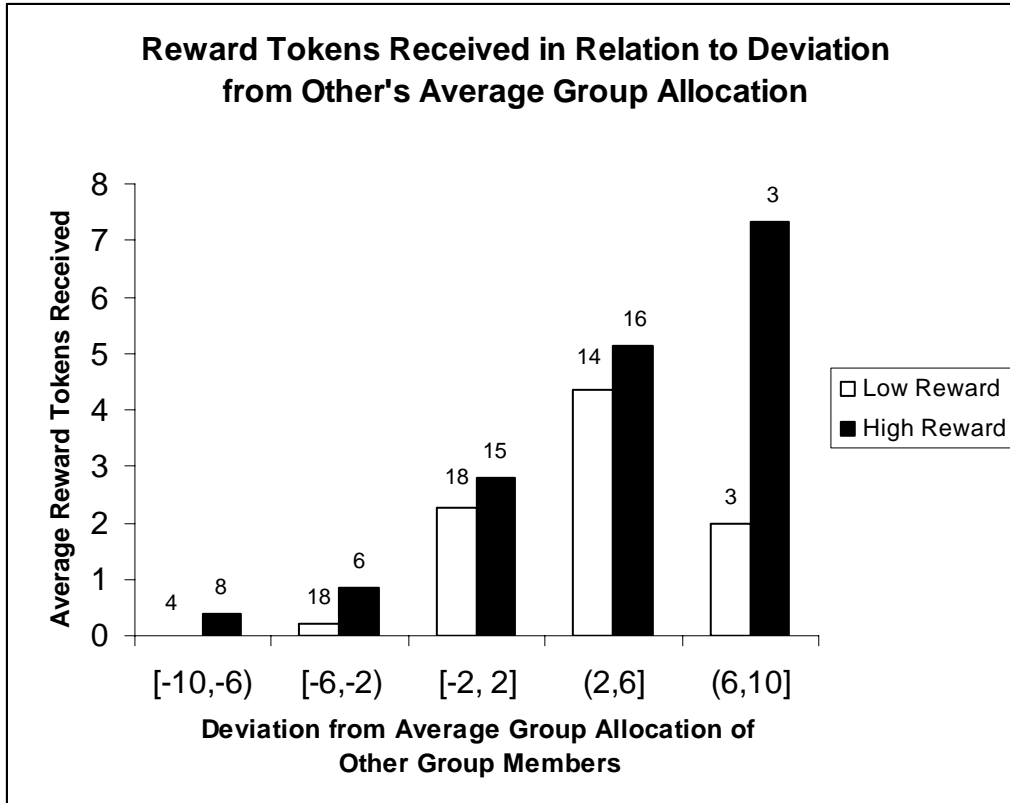


Figure 6. Standard Deviations of Group Account Allocations of Individual Subjects Across Decision Situations



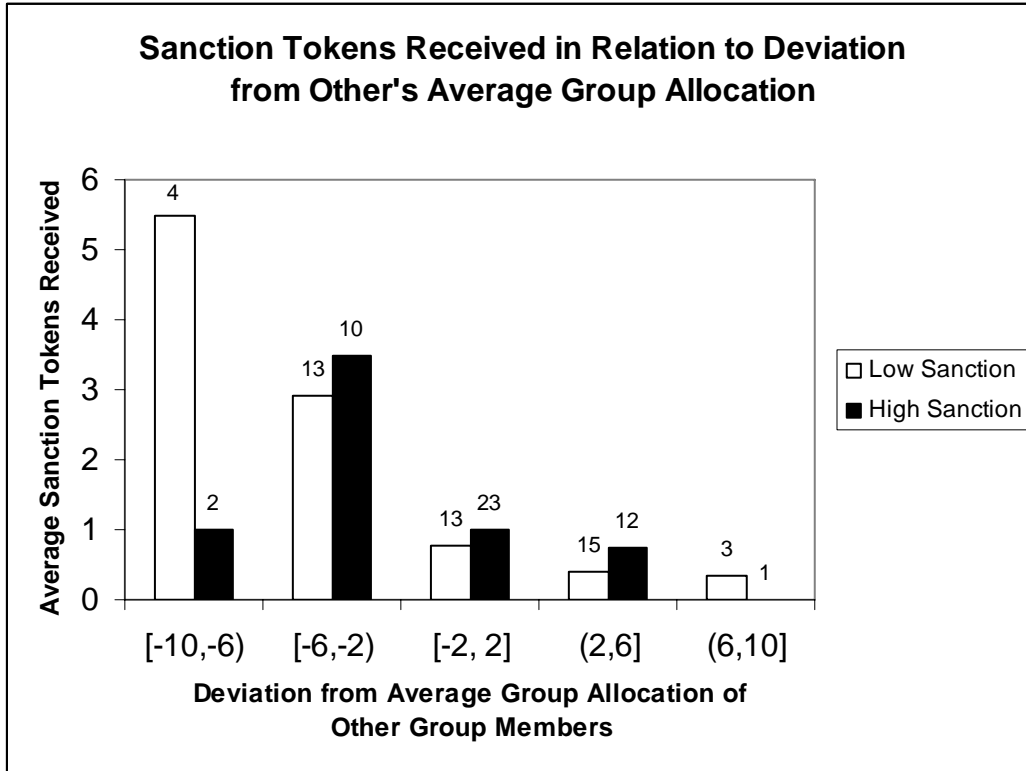
Note: Number on top of bar is the total number of subjects in the interval, each decision situation has a total of 48 subjects.

Figure 7. Reward Tokens Received in Relation to Deviation from Other's Average Group Allocation



Note: Number on top of bar is the total number of subjects in the interval, each decision situation has a total of 48 subjects.

Figure 8. Sanction Tokens Received in Relation to Deviation from Other's Average Group Allocation



Note: Number on top of bar is the total number of subjects in the interval, each decision situation has a total of 48 subjects.

## CHAPTER 3 - APPENDIX A - EXPERIMENTAL INSTRUCTIONS

Presented below are the instructions and decision sheets for the second decision situations ordering of the experiment.

### Initial Instructions

In this experiment, you will make choices in five different decision situations. After the experiment is over, we will randomly pick one of the five decision situations for computing earnings.

In each decision situation you will be randomly assigned into a group of four, you and 3 other participants. Therefore, you can expect the composition of your group to be different in each decision situation.

Each decision situation except the first consists of two stages. The first decision situation has no second stage.

First, you will receive instructions for each decision situation separately, and then be given time to make your first stage choices in that situation. After the first stage choices have been made in each decision situation, you will be given time to review and if you wish change any of the first stage choices that you made.

We will then collect the decision sheets and prepare them for you to make your second stage choices in each of the final four decision situations. We will again go through each situation one by one. After the second stage choices have been made, you will be given time to review and if you wish change any of the second stage choices that you made.

After all participants have had time to finalize their decisions, we will collect the decision sheets.

We will randomly pick one of the five decision situations for computing earnings.

Your earnings will depend on your decisions and the decisions of the participants that are in your group for the chosen decision situation.

While we are calculating your earnings, you can earn a further \$2 for completing a short, one page questionnaire.

At the end of the experiment, you will receive your \$5 show-up fee, your earnings from the decision situation that is randomly selected, and your \$2 for completing the questionnaire.

*You are participant \_\_\_\_\_ for all decision situations.*

### **Instructions for Decision Situation 1**

The instructions below describe the first decision situation and the way earnings will be determined if this decision situation is the one that is randomly selected.

For this decision situation you will be randomly assigned to a group of size four (you plus three other people).

In this decision situation, you will be endowed with 10 blue tokens. You must choose how many of these blue tokens to allocate to your PRIVATE ACCOUNT and how many blue tokens to allocate to a GROUP ACCOUNT. The amount of money you will earn in this decision situation depends on how many blue tokens you allocate to your private account, how many blue tokens you allocate to the group account, and how many blue tokens the others in your group allocate to the group account.

You can choose any number of blue tokens to allocate to the group account from 0 through 10 blue tokens. The remainder of your blue tokens will be allocated to your private account.

A blue token is worth \$1 when allocated to your private account.

For each blue token you allocate to the group account, you will earn 50 cents, and each of the other three people in your group will also earn 50 cents (a total of \$2 for all four of you together).

Each of the other participants in your group will also be endowed with 10 blue tokens.

For each blue token another person in your group allocates to their private account, they also earn \$1.

For each blue token another person in your group allocates to the group account, this person will earn 50 cents, and each of the other people in the group, you included, will also earn 50 cents (a total of \$2 for the group).

TO SUMMARIZE, in this decision situation you will earn:

\$1 times the number of blue tokens you allocate to your private account PLUS  
\$0.50 times the total number of blue tokens allocated to the group account by  
everyone in the group.

*You are participant \_\_\_\_\_ for all decision situations.*

**Decision Situation 1 Decision Sheet**

You have been endowed with 10 blue tokens.

In the box below, enter the amount of tokens you wish to allocate to the Group Account. Any remaining tokens will automatically be placed in your Private Account.

How many of your ten tokens do you wish to allocate to the group account?

Write a number from 0 to 10 here. \_\_\_\_\_

*You are participant \_\_\_\_\_ for all decision situations.*

## Instructions for Decision Situation 2

The instructions below describe the second decision situation and the way earnings will be determined if this decision situation is the one that is randomly selected.

For this decision situation you will be randomly assigned to a group of size four (you plus three other people).

This decision situation consists of **two stages**. When you have completed the first stage for all five decision situations, we will collect your decision sheets and prepare them for the second stage. They will then be returned to you so that the second stage decisions can be completed.

### The First Stage

In the first stage, the decision you will make is just like the decision you made in Decision Situation 1.

In the first stage you are endowed with 10 blue tokens, and the other three participants in your group are also endowed with 10 blue tokens. You must decide how many of these blue tokens to allocate to the GROUP ACCOUNT, and how many to allocate to your PRIVATE ACCOUNT.

In the first stage you will earn:

\$1 times the number of blue tokens you allocate to your private account PLUS  
\$0.50 times the total number of blue tokens allocated to the group account by everyone  
in the group.

### The Second Stage

On your Decision Situation 2 decision sheet, you will be informed of the total allocation to the group account and your total earnings for the first stage. You will also be informed of the individual group account allocation decisions of the other members of your group. Information about individual choices will be completely anonymous, you will never know the identities of the other members of your group.

In the 2nd stage you are endowed with 10 green tokens. A green token can be allocated to your PRIVATE ACCOUNT, or used to **decrease** the Decision Situation 2 earnings of the other members of your group.

If you allocate a green token to your private account it will increase your Decision Situation 2 earnings by 20 cents.

If you use a green token to decrease the earnings of another group member in this decision situation, it will decrease that group member's Decision Situation 2 earnings by 40 cents .

You can choose any number of green tokens to allocate to your private account, from 0 to 10 green tokens, and any number to increase the earnings of each of the other group members, also any number from 0 to 10 green tokens. However, the number of green tokens you allocate to your private account and to increasing the earnings of other group members must sum to 10.

The other three members of your group will also be endowed with 10 green tokens in the second stage, and will be able to use them in the same way.

*You are participant \_\_\_\_\_ for all decision situations.*

**Decision Situation 2 Decision Sheet**

First Stage

In the first stage you have been endowed with 10 blue tokens.

In the box below, enter the amount of blue tokens you wish to allocate to the Group Account. Any remaining blue tokens will automatically be placed in your Private Account.

How many of your ten tokens do you wish to allocate to the group account?

Write a number from 0 to 10 here. \_\_\_\_\_

Second Stage

\_\_\_\_\_ blue tokens were allocated to the group account by your group in the first stage.

You earned \_\_\_\_\_ in the first stage.

In this stage you are endowed with 10 green tokens.

The first column of each row below shows how many blue tokens another group member allocated to the Group Account in the first stage. In the column to the right, enter the number of green tokens you wish to use to **decrease** that group member's Decision Situation 2 earnings. You may enter any number from 0 to 10 for each group member below, but all the numbers you enter must add up to 10 OR LESS. Any remaining green tokens will automatically be placed in your Private Account.

<b>Allocations to Group Account by Other Group Members</b>	<b>Number of Tokens to Decrease this Member's Earnings</b>
_____	_____
_____	_____
_____	_____

You are participant \_\_\_\_\_ for all decision situations.

### Instructions for Decision Situation 3

The instructions below describe the third decision situation and the way earnings will be determined if this decision situation is the one that is randomly selected.

For this decision situation you will be randomly assigned to a group of size four (you plus three other people).

This decision situation consists of **two stages**. When you have completed the first stage for all five decision situations, we will collect your decision sheets and prepare them for the second stage. They will then be returned to you so that the second stage decisions can be completed.

#### The First Stage

In the first stage, the decision you will make is just like the decision you made in Decision Situation 1.

In the first stage you are endowed with 10 blue tokens, and the other three participants in your group are also endowed with 10 blue tokens. You must decide how many of these blue tokens to allocate to the GROUP ACCOUNT, and how many to allocate to your PRIVATE ACCOUNT.

In the first stage you will earn:

\$1 times the number of blue tokens you allocate to your private account PLUS  
\$0.50 times the total number of blue tokens allocated to the group account by everyone  
in the group.

#### The Second Stage

On your Decision Situation 3 decision sheet, you will be informed of the total allocation to the group account and your total earnings for the first stage. You will also be informed of the individual group account allocation decisions of the other members of your group. Information about individual choices will be completely anonymous, you will never know the identities of the other members of your group.

In the 2nd stage you are endowed with 10 green tokens. A green token can be allocated to your PRIVATE ACCOUNT, or used to **increase** the Decision Situation 3 earnings of the other members of your group.

If you allocate a green token to your private account it will increase your Decision Situation 3 earnings by 20 cents.

If you use a green token to increase the earnings of another group member in this decision situation, it will either increase that group member's Decision Situation 3 earnings by 40 cents.

You can choose any number of green tokens to allocate to your private account, from 0 to 10 green tokens, and any number to increase the earnings of each of the other group members, also any number from 0 to 10 green tokens. However, the number of green tokens you allocate to your private account and to increasing the earnings of other group members must sum to 10.

The other three members of your group will also be endowed with 10 green tokens in the second stage, and will be able to use them in the same way.

*You are participant \_\_\_\_\_ for all decision situations.*

### Decision Situation 3 Decision Sheet

#### First Stage

In the first stage you have been endowed with 10 blue tokens.

In the box below, enter the amount of blue tokens you wish to allocate to the Group Account. Any remaining blue tokens will automatically be placed in your Private Account.

How many of your ten tokens do you wish to allocate to the group account?

Write a number from 0 to 10 here. \_\_\_\_\_

#### Second Stage

\_\_\_\_\_ blue tokens were allocated to the group account by your group in the first stage.

You earned \_\_\_\_\_ in the first stage.

In this stage you are endowed with 10 green tokens.

The first column of each row below shows how many blue tokens another group member allocated to the Group Account in the first stage. In the column to the right, enter the number of green tokens you wish to use to **increase** that group member's Decision Situation 3 earnings. You may enter any number from 0 to 10 for each group member below, but all the numbers you enter must add up to 10 OR LESS. Any remaining green tokens will automatically be placed in your Private Account.

<b>Allocations to Group Account by Other Group Members</b>	<b>Number of Tokens to Increase this Member's Earnings</b>
_____	_____
_____	_____
_____	_____

You are participant \_\_\_\_\_ for all decision situations.

### Instructions for Decision Situation 4

The instructions below describe the fourth decision situation and the way earnings will be determined if this decision situation is the one that is randomly selected.

For this decision situation you will be randomly assigned to a group of size four (you plus three other people).

This decision situation consists of **two stages**. When you have completed the first stage for all five decision situations, we will collect your decision sheets and prepare them for the second stage. They will then be returned to you so that the second stage decisions can be completed.

#### The First Stage

In the first stage, the decision you will make is just like the decision you made in Decision Situation 1.

In the first stage you are endowed with 10 blue tokens, and the other three participants in your group are also endowed with 10 blue tokens. You must decide how many of these blue tokens to allocate to the GROUP ACCOUNT, and how many to allocate to your PRIVATE ACCOUNT.

In the first stage you will earn:

\$1 times the number of blue tokens you allocate to your private account PLUS  
\$0.50 times the total number of blue tokens allocated to the group account by everyone  
in the group.

#### The Second Stage

On your Decision Situation 4 decision sheet, you will be informed of the total allocation to the group account and your total earnings for the first stage. You will also be informed of the individual group account allocation decisions of the other members of your group. Information about individual choices will be completely anonymous, you will never know the identities of the other members of your group.

In the 2nd stage you are endowed with 10 green tokens. A green token can be allocated to your PRIVATE ACCOUNT, or used to **decrease** the Decision Situation 4 earnings of the other members of your group.

If you allocate a green token to your private account it will increase your Decision Situation 4 earnings by 20 cents.

If you use a green token to decrease the earnings of another group member in this decision situation, it will decrease that member's Decision Situation 4 earnings by 20 cents.

You can choose any number of green tokens to allocate to your private account, from 0 to 10 green tokens, and any number to decrease the earnings of each of the other group members, also any number from 0 to 10 green tokens. However, the number of green tokens you allocate to your private account and to decreasing the earnings of other group members must sum to 10.

The other three members of your group will also be endowed with 10 green tokens in the second stage, and will be able to use them in the same way.

*You are participant \_\_\_\_\_ for all decision situations.*

## Decision Situation 4 Decision Sheet

### First Stage

In the first stage you have been endowed with 10 blue tokens.

In the box below, enter the amount of blue tokens you wish to allocate to the Group Account. Any remaining blue tokens will automatically be placed in your Private Account.

How many of your ten tokens do you wish to allocate to the group account?

Write a number from 0 to 10 here. \_\_\_\_\_

### Second Stage

\_\_\_\_\_ blue tokens were allocated to the group account by your group in the first stage.

You earned \_\_\_\_\_ in the first stage.

In this stage you are endowed with 10 green tokens.

The first column of each row below shows how many blue tokens another group member allocated to the Group Account in the first stage. In the column to the right, enter the number of green tokens you wish to use to **decrease** that group member's Decision Situation 4 earnings. You may enter any number from 0 to 10 for each group member below, but all the numbers you enter must add up to 10 OR LESS. Any remaining green tokens will automatically be placed in your Private Account.

<b>Allocations to Group Account by Other Group Members</b>	<b>Number of Tokens to Decrease this Member's Earnings</b>
_____	_____
_____	_____
_____	_____

You are participant \_\_\_\_\_ for all decision situations.

### Instructions for Decision Situation 5

The instructions below describe the fifth decision situation and the way earnings will be determined if this decision situation is the one that is randomly selected.

For this decision situation you will be randomly assigned to a group of size four (you plus three other people).

This decision situation consists of **two stages**. When you have completed the first stage for all five decision situations, we will collect your decision sheets and prepare them for the second stage. They will then be returned to you so that the second stage decisions can be completed.

#### The First Stage

In the first stage, the decision you will make is just like the decision you made in Decision Situation 1.

In the first stage you are endowed with 10 blue tokens, and the other three participants in your group are also endowed with 10 blue tokens. You must decide how many of these blue tokens to allocate to the GROUP ACCOUNT, and how many to allocate to your PRIVATE ACCOUNT.

In the first stage you will earn:

\$1 times the number of blue tokens you allocate to your private account PLUS  
\$0.50 times the total number of blue tokens allocated to the group account by everyone  
in the group.

#### The Second Stage

On your Decision Situation 5 decision sheet, you will be informed of the total allocation to the group account and your total earnings for the first stage. You will also be informed of the individual group account allocation decisions of the other members of your group. Information about individual choices will be completely anonymous, you will never know the identities of the other members of your group.

In the 2nd stage you are endowed with 10 green tokens. A green token can be allocated to your PRIVATE ACCOUNT, or used to **increase** the Decision Situation 5 earnings of the other members of your group.

If you allocate a green token to your private account it will increase your Decision Situation 5 earnings by 20 cents.

If you use a green token to increase the earnings of another group member in this decision situation, it will increase that member's Decision Situation 5 earnings by 20 cents.

You can choose any number of green tokens to allocate to your private account, from 0 to 10 green tokens, and any number to increase the earnings of each of the other group members, also any number from 0 to 10 green tokens. However, the number of green tokens you allocate to your private account and to increasing the earnings of other group members must sum to 10.

The other three members of your group will also be endowed with 10 green tokens in the second stage, and will be able to use them in the same way.

*You are participant \_\_\_\_\_ for all decision situations.*

**Decision Situation 5 Decision Sheet**

First Stage

In the first stage you have been endowed with 10 blue tokens.

In the box below, enter the amount of blue tokens you wish to allocate to the Group Account. Any remaining blue tokens will automatically be placed in your Private Account.

How many of your ten tokens do you wish to allocate to the group account?

Write a number from 0 to 10 here. \_\_\_\_\_

Second Stage

\_\_\_\_\_ blue tokens were allocated to the group account by your group in the first stage.

You earned \_\_\_\_\_ in the first stage.

In this stage you are endowed with 10 green tokens.

The first column of each row below shows how many blue tokens another group member allocated to the Group Account in the first stage. In the column to the right, enter the number of green tokens you wish to use to **increase** that group member's Decision Situation 5 earnings. You may enter any number from 0 to 10 for each group member below, but all the numbers you enter must add up to 10 OR LESS. Any remaining green tokens will automatically be placed in your Private Account.

<b>Allocations to Group Account by Other Group Members</b>	<b>Number of Tokens to Increase this Member's Earnings</b>
_____	_____
_____	_____
_____	_____

*You are participant \_\_\_\_\_ for all decision situations.*

## CHAPTER 3 - APPENDIX B - EXPERIMENTAL DATA

Four experiments with twelve subjects took place, for a total of 48 subjects. Within each experiment, the twelve subjects were placed into different random 4-person groups for each of the decision situations. All data in terms of "blue" or "green" tokens used.

### 1. Group Account Allocations in Each Decision Situation

		Baseline VCM	Low Reward	Low Sanction	High Reward	High Sanction
EX 1	Subject 1	10	7	8	10	10
	Subject 2	0	0	0	0	0
	Subject 3	2	2	2	2	2
	Subject 4	10	9	8	8	8
	Subject 5	1	3	6	3	6
	Subject 6	10	10	10	10	10
	Subject 7	10	10	10	10	10
	Subject 8	3	5	0	6	7
	Subject 9	0	0	4	0	8
	Subject 10	3	3	4	5	4
	Subject 11	3	3	4	3	8
	Subject 12	5	7	6	4	4
EX 2	Subject 13	2	2	0	2	2
	Subject 14	1	2	3	8	4
	Subject 15	0	0	0	0	0
	Subject 16	6	4	4	4	4
	Subject 17	5	9	4	7	7
	Subject 18	7	3	0	4	0
	Subject 19	2	2	3	3	2
	Subject 20	10	10	10	10	10
	Subject 21	10	10	10	10	10
	Subject 22	0	0	5	5	5
	Subject 23	10	10	10	10	10
	Subject 24	10	10	10	10	10
EX 3	Subject 25	0	0	1	0	5
	Subject 26	2	0	4	0	6
	Subject 27	10	10	10	10	10
	Subject 28	2	0	4	1	3
	Subject 29	9	10	10	10	9
	Subject 30	10	10	10	10	10
	Subject 31	7	8	8	8	9
	Subject 32	10	10	10	10	10
	Subject 33	7	9	9	8	7
	Subject 34	9	9	9	9	9
	Subject 35	0	0	4	5	7
	Subject 36	5	3	5	3	8

		Baseline VCM	Low Reward	Low Sanction	High Reward	High Sanction
EX 4	Subject 37	10	10	10	10	10
	Subject 38	10	10	10	10	10
	Subject 39	10	10	10	10	10
	Subject 40	8	10	10	10	10
	Subject 41	10	10	10	10	10
	Subject 42	4	3	3	4	4
	Subject 43	8	8	10	10	8
	Subject 44	4	3	2	5	0
	Subject 45	2	0	0	5	0
	Subject 46	10	10	10	10	10
	Subject 47	7	5	6	6	5
	Subject 48	3	1	5	2	6

## 2. Use of Sanctions and Rewards

### A. Low Reward Decision Situation

Data is given for the group account allocation of the particular subject, the group account allocations of each of the other group members paired with the subject, the number of tokens used by the subject to reward each other group member, and the number of tokens the subject received in reward from each other group member.

GA : group account allocation of subject

FGM 1 GA: group account allocation of first fellow group member

RG FGM 1: reward tokens used by subject to reward first fellow group member

RR FGM 1: reward tokens used by first fellow group member to reward the subject

FGM 2 GA: group account allocation of second fellow group member

RG FGM 2: reward tokens used by subject to reward second fellow group member

RR FGM 2: reward tokens used by second fellow group member to reward the subject

FGM 3 GA: group account allocation of third fellow group member

RG FGM 3: reward tokens used by subject to reward third fellow group member

RR FGM 3: reward tokens used by third fellow group member to reward the subject

		GA	FGM 1 GA	RG FGM 1	RR FGM 1	FGM 2 GA	RG FGM 2	RR FGM 2	FGM 3 GA	RG FGM 3	RR FGM 3
EX 1	Subject 1	7	10	1	0	2	0	3	0	0	0
	Subject 2	0	10	0	0	2	0	0	7	0	0
	Subject 3	2	10	2	0	0	0	0	7	3	0
	Subject 4	9	3	0	2	10	0	0	3	0	5
	Subject 5	3	10	3	0	3	0	0	9	2	0
	Subject 6	10	3	0	3	3	0	5	9	0	0
	Subject 7	10	2	0	2	0	0	0	7	0	1
	Subject 8	5	3	1	2	7	3	1	0	0	0
	Subject 9	0	3	0	0	7	0	0	5	0	0
	Subject 10	3	3	0	0	10	5	0	9	5	0
	Subject 11	3	7	3	1	5	2	1	0	0	0
	Subject 12	7	3	1	3	5	1	3	0	0	0

		GA	FGM 1 GA	RG FGM 1	RR FGM 1	FGM 2 GA	RG FGM 2	RR FGM 2	FGM 3 GA	RG FGM 3	RR FGM 3
EX 2	Subject 13	2	2	2	0	0	0	0	2	2	0
	Subject 14	2	2	0	0	0	0	0	2	0	2
	Subject 15	0	2	0	0	2	0	0	2	0	0
	Subject 16	4	9	0	2	3	0	0	0	0	0
	Subject 17	9	3	2	0	0	2	0	4	2	0
	Subject 18	3	9	0	2	0	0	0	4	0	0
	Subject 19	2	0	0	0	2	0	0	2	0	2
	Subject 20	10	10	0	0	10	0	1	10	0	0
	Subject 21	10	10	0	0	10	0	1	10	0	0
	Subject 22	0	9	0	2	3	0	0	4	0	0
	Subject 23	10	10	0	1	10	0	0	10	0	0
	Subject 24	10	10	1	0	10	1	0	10	1	0
EX 3	Subject 25	0	8	8	0	10	1	0	0	0	0
	Subject 26	0	8	0	0	10	2	0	0	0	0
	Subject 27	10	8	0	0	0	0	2	0	0	1
	Subject 28	0	10	0	0	10	0	0	9	0	0
	Subject 29	10	10	3	0	9	3	5	0	0	0
	Subject 30	10	10	0	3	9	0	5	0	0	0
	Subject 31	8	10	0	0	0	0	0	0	0	8
	Subject 32	10	0	0	0	3	0	0	9	1	0
	Subject 33	9	0	0	0	3	0	0	10	0	1
	Subject 34	9	10	5	3	10	5	0	0	0	0
	Subject 35	0	3	0	0	10	0	0	9	0	0
	Subject 36	3	0	0	0	10	0	0	9	0	0

		GA	FGM 1 GA	RG FGM 1	RR FGM 1	FGM 2 GA	RG FGM 2	RR FGM 2	FGM 3 GA	RG FGM 3	RR FGM 3
EX 4	Subject 37	10	8	0	1	10	0	2	10	0	4
	Subject 38	10	8	2	1	10	4	2	10	4	0
	Subject 39	10	8	1	1	10	2	4	10	2	0
	Subject 40	10	10	3	0	3	0	1	10	3	0
	Subject 41	10	3	0	2	10	0	0	10	0	3
	Subject 42	3	10	2	0	10	2	0	10	1	0
	Subject 43	8	10	1	1	10	1	2	10	1	0
	Subject 44	3	5	0	3	1	0	0	0	0	2
	Subject 45	0	5	1	0	1	2	0	3	2	0
	Subject 46	10	10	0	0	3	0	2	10	0	3
	Subject 47	5	1	0	0	3	3	0	0	0	1
	Subject 48	1	5	0	0	3	0	0	0	0	2

## B. Low Sanction Decision Situation

Data is given for the group account allocation of the particular subject, the group account allocations of each of the other group members paired with the subject, the number of tokens used by the subject to sanction each other group member, and the number of tokens the subject received to sanction from each other group member.

GA : group account allocation of subject

FGM 1 GA: group account allocation of first fellow group member

SG FGM 1: sanction tokens used by subject to sanction first fellow group member

SR FGM 1: sanction tokens used by first fellow group member to sanction the subject

FGM 2 GA: group account allocation of second fellow group member

SG FGM 2: sanction tokens used by subject to sanction second fellow group member

SR FGM 2: sanction tokens used by second fellow group member to sanction the subject

FGM 3 GA: group account allocation of third fellow group member

SG FGM 3: sanction tokens used by subject to sanction third fellow group member

SR FGM 3: sanction tokens used by third fellow group member to sanction the subject

		GA	FGM 1 GA	SG FGM 1	SR FGM 1	FGM 2 GA	SG FGM 2	SR FGM 2	FGM 3 GA	SG FGM 3	SR FGM 3
EX 1	Subject 1	8	2	0	0	4	0	0	4	0	0
	Subject 2	0	6	0	4	4	0	2	8	0	5
	Subject 3	2	8	0	0	4	0	0	4	0	0
	Subject 4	8	0	5	0	6	0	0	4	0	0
	Subject 5	6	0	4	0	4	1	0	8	0	0
	Subject 6	10	10	0	0	0	0	1	6	0	2
	Subject 7	10	0	5	1	6	0	2	10	0	0
	Subject 8	0	10	1	5	6	2	1	10	1	0
	Subject 9	4	0	2	0	6	0	1	8	0	0
	Subject 10	4	2	0	0	8	0	0	4	0	0
	Subject 11	4	2	0	0	8	0	0	4	0	0
	Subject 12	6	10	2	0	0	1	2	10	2	0

		GA	FGM 1 GA	SG FGM 1	SR FGM 1	FGM 2 GA	SG FGM 2	SR FGM 2	FGM 3 GA	SG FGM 3	SR FGM 3
EX 2	Subject 13	0	0	0	0	5	0	0	10	0	0
	Subject 14	3	4	0	1	10	0	0	4	0	0
	Subject 15	0	0	0	0	5	0	0	10	0	0
	Subject 16	4	3	0	0	4	0	1	10	0	0
	Subject 17	4	3	1	0	10	1	0	4	1	0
	Subject 18	0	3	0	0	10	0	0	10	0	1
	Subject 19	3	10	0	0	10	0	1	0	0	0
	Subject 20	10	3	0	0	10	0	0	0	0	0
	Subject 21	10	3	0	0	4	0	1	4	0	0
	Subject 22	5	0	0	0	0	0	0	10	0	0
	Subject 23	10	0	0	0	0	0	0	5	0	0
	Subject 24	10	3	1	0	10	0	0	0	1	0
EX 3	Subject 25	1	10	0	5	9	0	5	4	0	0
	Subject 26	4	10	0	1	9	0	2	4	0	0
	Subject 27	10	1	5	0	9	0	0	4	0	0
	Subject 28	4	4	0	0	10	0	1	9	0	2
	Subject 29	10	4	1	0	9	0	0	4	1	0
	Subject 30	10	8	0	0	10	0	0	5	0	0
	Subject 31	8	10	0	0	5	0	0	10	0	0
	Subject 32	10	8	0	0	5	1	0	10	0	0
	Subject 33	9	4	2	0	10	0	0	4	2	0
	Subject 34	9	10	0	0	1	5	0	4	3	0
	Subject 35	4	10	0	0	1	0	0	9	0	3
	Subject 36	5	8	0	0	10	0	1	10	0	0

		GA	FGM 1 GA	SG FGM 1	SR FGM 1	FGM 2 GA	SG FGM 2	SR FGM 2	FGM 3 GA	SG FGM 3	SR FGM 3
EX 4	Subject 37	10	10	0	0	10	0	0	6	0	2
	Subject 38	10	10	0	0	0	0	0	10	0	0
	Subject 39	10	10	0	0	10	0	0	6	0	2
	Subject 40	10	10	0	0	10	0	0	0	5	0
	Subject 41	10	10	0	0	0	0	0	10	0	0
	Subject 42	3	10	0	1	2	0	0	5	0	0
	Subject 43	10	2	9	0	5	0	0	3	1	0
	Subject 44	2	10	0	9	5	0	1	3	0	0
	Subject 45	0	10	0	0	10	0	0	10	0	5
	Subject 46	10	10	0	0	10	0	0	6	4	2
	Subject 47	6	10	2	0	10	2	0	10	2	4
	Subject 48	5	10	0	0	2	1	0	3	0	0

### C. High Reward Decision Situation

Data is given for the group account allocation of the particular subject, the group account allocations of each of the other group members paired with the subject, the number of tokens used by the subject to reward each other group member, and the number of tokens the subject received in reward from each other group member.

GA : group account allocation of subject

FGM 1 GA: group account allocation of first fellow group member

RG FGM 1: reward tokens used by subject to reward first fellow group member

RR FGM 1: reward tokens used by first fellow group member to reward the subject

FGM 2 GA: group account allocation of second fellow group member

RG FGM 2: reward tokens used by subject to reward second fellow group member

RR FGM 2: reward tokens used by second fellow group member to reward the subject

FGM 3 GA: group account allocation of third fellow group member

RG FGM 3: reward tokens used by subject to reward third fellow group member

RR FGM 3: reward tokens used by third fellow group member to reward the subject

		GA	FGM 1 GA	RG FGM 1	RR FGM 1	FGM 2 GA	RG FGM 2	RR FGM 2	FGM 3 GA	RG FGM 3	RR FGM 3
EX 1	Subject 1	10	0	0	0	5	0	3	10	2	0
	Subject 2	0	10	0	0	5	0	0	10	0	0
	Subject 3	2	4	1	0	3	0	0	8	2	0
	Subject 4	8	4	0	2	3	0	3	2	0	2
	Subject 5	3	4	0	1	8	3	0	2	0	0
	Subject 6	10	0	0	0	10	0	2	5	0	3
	Subject 7	10	0	0	0	6	0	4	3	0	5
	Subject 8	6	0	0	0	10	4	0	3	1	4
	Subject 9	0	6	0	0	10	0	0	3	0	0
	Subject 10	5	0	0	0	10	3	0	10	3	0
	Subject 11	3	0	0	0	6	4	1	10	5	0
	Subject 12	4	3	1	0	8	2	0	2	0	1

		GA	FGM 1 GA	RG FGM 1	RR FGM 1	FGM 2 GA	RG FGM 2	RR FGM 2	FGM 3 GA	RG FGM 3	RR FGM 3
EX 2	Subject 13	2	8	3	0	5	3	0	4	3	0
	Subject 14	8	2	0	3	5	0	0	4	0	0
	Subject 15	0	10	0	0	7	0	0	4	0	0
	Subject 16	4	10	0	1	7	0	1	0	0	0
	Subject 17	7	10	2	2	4	1	0	0	0	0
	Subject 18	4	8	0	0	2	0	3	5	0	0
	Subject 19	3	10	0	0	10	0	3	10	0	0
	Subject 20	10	10	3	0	3	3	0	10	4	0
	Subject 21	10	10	0	3	3	0	0	10	0	0
	Subject 22	5	8	0	0	2	0	3	4	0	0
	Subject 23	10	10	0	0	10	0	4	3	0	0
	Subject 24	10	7	2	2	4	1	0	0	0	0
EX 3	Subject 25	0	0	0	0	9	5	0	10	4	0
	Subject 26	0	0	0	0	9	1	0	10	2	0
	Subject 27	10	3	0	1	10	0	5	1	0	2
	Subject 28	1	3	0	0	10	2	0	10	2	0
	Subject 29	10	3	2	1	1	0	2	10	5	0
	Subject 30	10	0	0	2	0	0	4	9	5	5
	Subject 31	8	8	0	0	10	0	1	5	0	0
	Subject 32	10	8	1	3	8	1	0	5	0	0
	Subject 33	8	10	3	1	8	0	0	5	0	0
	Subject 34	9	0	0	1	0	0	5	10	5	5
	Subject 35	5	8	0	0	10	0	0	8	0	0
	Subject 36	3	10	1	2	1	0	0	10	1	0

		GA	FGM 1 GA	RG FGM 1	RR FGM 1	FGM 2 GA	RG FGM 2	RR FGM 2	FGM 3 GA	RG FGM 3	RR FGM 3
EX 4	Subject 37	10	10	0	4	10	0	4	4	0	1
	Subject 38	10	10	4	0	10	4	4	4	2	2
	Subject 39	10	2	0	1	10	2	5	10	3	3
	Subject 40	10	2	0	1	10	3	5	10	3	3
	Subject 41	10	2	0	1	10	5	3	10	5	2
	Subject 42	4	10	2	2	10	1	0	10	1	0
	Subject 43	10	5	0	1	5	0	3	6	0	2
	Subject 44	5	5	0	2	10	3	0	6	0	1
	Subject 45	5	5	2	0	10	1	0	6	2	1
	Subject 46	10	10	4	4	10	4	0	4	0	1
	Subject 47	6	5	1	2	5	1	0	10	2	0
	Subject 48	2	10	1	0	10	1	0	10	1	0

#### D. High Sanction Decision Situation

Data is given for the group account allocation of the particular subject, the group account allocations of each of the other group members paired with the subject, the number of tokens used by the subject to sanction each other group member, and the number of tokens the subject received to sanction from each other group member.

GA : group account allocation of subject

FGM 1 GA: group account allocation of first fellow group member

SG FGM 1: sanction tokens used by subject to sanction first fellow group member

SR FGM 1: sanction tokens used by first fellow group member to sanction the subject

FGM 2 GA: group account allocation of second fellow group member

SG FGM 2: sanction tokens used by subject to sanction second fellow group member

SR FGM 2: sanction tokens used by second fellow group member to sanction the subject

FGM 3 GA: group account allocation of third fellow group member

SG FGM 3: sanction tokens used by subject to sanction third fellow group member

SR FGM 3: sanction tokens used by third fellow group member to sanction the subject

		GA	FGM 1 GA	SG FGM 1	SR FGM 1	FGM 2 GA	SG FGM 2	SR FGM 2	FGM 3 GA	SG FGM 3	SR FGM 3
EX 1	Subject 1	10	8	0	0	7	0	2	10	0	0
	Subject 2	0	2	0	3	4	0	2	8	0	10
	Subject 3	2	4	0	0	0	3	0	8	0	0
	Subject 4	8	2	0	0	4	0	0	0	10	0
	Subject 5	6	8	0	0	10	0	0	4	2	2
	Subject 6	10	8	0	0	10	0	0	7	0	2
	Subject 7	10	8	0	0	6	0	0	4	5	2
	Subject 8	7	8	4	0	10	2	0	10	2	0
	Subject 9	8	10	0	0	7	0	4	10	0	0
	Subject 10	4	2	0	0	0	2	0	8	0	0
	Subject 11	8	6	0	0	10	0	0	4	0	2
	Subject 12	4	8	2	0	6	2	2	10	2	5

		GA	FGM 1 GA	SG FGM 1	SR FGM 1	FGM 2 GA	SG FGM 2	SR FGM 2	FGM 3 GA	SG FGM 3	SR FGM 3
EX 2	Subject 13	2	10	0	0	10	0	0	0	0	0
	Subject 14	4	0	0	0	5	0	0	4	0	0
	Subject 15	0	5	0	0	4	0	0	4	0	0
	Subject 16	4	0	0	0	5	0	0	4	0	0
	Subject 17	7	10	1	0	2	2	0	10	1	0
	Subject 18	0	10	0	0	2	0	0	10	0	0
	Subject 19	2	10	0	0	7	0	2	10	0	0
	Subject 20	10	10	0	0	2	0	0	0	0	0
	Subject 21	10	2	0	0	10	0	0	0	0	0
	Subject 22	5	0	0	0	4	0	0	4	0	0
	Subject 23	10	7	0	1	2	0	0	10	0	0
	Subject 24	10	10	0	0	7	0	1	2	0	0
	EX 3	Subject 25	5	7	0	0	10	0	1	10	0
Subject 26		6	10	0	0	9	0	3	3	0	0
Subject 27		10	9	0	0	6	0	0	3	5	3
Subject 28		3	10	3	5	9	2	5	6	0	0
Subject 29		9	7	0	0	9	0	0	8	0	0
Subject 30		10	7	0	0	5	0	0	10	0	0
Subject 31		9	7	0	0	9	0	0	8	0	0
Subject 32		10	7	1	0	5	1	0	10	0	0
Subject 33		7	5	0	0	10	0	1	10	0	0
Subject 34		9	10	0	0	6	3	0	3	5	2
Subject 35		7	9	0	0	9	0	0	8	0	0
Subject 36		8	7	0	0	9	0	0	9	0	0

		GA	FGM 1 GA	SG FGM 1	SR FGM 1	FGM 2 GA	SG FGM 2	SR FGM 2	FGM 3 GA	SG FGM 3	SR FGM 3
EX 4	Subject 37	10	0	0	0	0	0	0	4	0	0
	Subject 38	10	10	0	0	10	0	0	10	0	0
	Subject 39	10	10	0	0	10	0	0	10	0	0
	Subject 40	10	10	0	0	10	0	0	10	0	0
	Subject 41	10	5	0	0	8	0	0	6	0	0
	Subject 42	4	0	0	0	10	0	0	0	0	0
	Subject 43	8	5	2	0	10	0	0	6	3	0
	Subject 44	0	0	0	0	10	0	0	4	0	0
	Subject 45	0	10	0	0	0	0	0	4	0	0
	Subject 46	10	10	0	0	10	0	0	10	0	0
	Subject 47	5	10	0	0	8	0	2	6	4	0
	Subject 48	6	5	0	4	10	0	0	8	0	3

## CHAPTER 4

### **The Voluntary Provision of a Public Good with Binding Multi-Round Commitments**

#### **1. Introduction**

Previous VCM studies suggest that reciprocity considerations play an important role in explaining allocations to the group account.<sup>29</sup> In the repeated VCM environment, expectations of reciprocity by other group members may lead a subject to make a group-account allocation in one decision round in order to induce larger group-account allocations from other group members in future rounds. This chapter reports experiments that add to the traditional repeated VCM setting by allowing subjects to make binding multi-round commitments to the group account, before subjects choose their final allocation. These commitments are made simultaneously within the group, and the aggregate group commitment is made public before final allocations are made. This process is repeated at 5-round intervals.

The multi-round commitment environment investigated here, while essentially artificial, has similarities to naturally occurring examples of public goods fund raising. The multi-round nature of commitments is similar to mechanisms of public goods provision in which contributors commit to contribute a minimum amount at repeating intervals of time. For example, The Public Broadcasting System operates fund drives that regularly announce the current level of pledges which are often collected through regular payroll deductions. Similarly, religious organizations rely

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<sup>29</sup> See Croson (1999) as an example.

significantly on members making pledges toward regular, weekly or monthly, donations. Such pledges are often made public as part of “real time” fund drives.<sup>30</sup>

This study finds that subjects on average tend to make commitments in the range of one quarter to one third of endowments. However, commitments do not increase overall average group-account allocations relative to a control VCM environment without commitment opportunities. On the other hand, further analysis reveals that commitments affect within-group behavior differentially. The results show that the variance of outcomes across groups is larger in multi-round commitment experiments than in control experiments.

The chapter is structured as follows. The following section discusses previous experimental research of a similar nature to this chapter. Section 3 provides a description of the experimental design. Section 4 provides several conjectures of behavior based on subjects following norms of reciprocity. Section 5 presents the experimental results. Finally, Section 6 contains concluding remarks.<sup>31</sup>

## **2. Previous Experimental Research**

Chen and Komorita (1994) examine several forms of commitment mechanisms in a two stage game that is repeated for 10 decision rounds. In the first stage of each round, subjects in a 5 person group are given the opportunity to make a commitment. The second stage of each round is a VCM game. Their "binding pledge" condition is most analogous to the commitment mechanism of this chapter. In each decision round, subjects make a binding minimum commitment to the group

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<sup>30</sup> Similarly, charities often announce a large "leadership" donation. List and Reilly (2002) presents a field experiment confirming that “seed money” can significantly increase the effectiveness of fundraising by encouraging more frequent and larger contributions.

<sup>31</sup> The research presented in the chapter will be published in Halloran, Walker, and Williams (2005).

account. In this condition, they find that subjects tend to commit between 20% and 30% of their endowments.<sup>32</sup> However, levels of group allocations are not increased relative to experiments without commitment opportunities. The multi-round commitment design of this study allows further examination of Chen and Komorita's conclusions, and examination of the extent to which multi-round commitments have a different impact than single-round commitment mechanisms. In addition, Chen and Komorita do not report results related to how the impact of commitments may vary across decision making groups or decision rounds. As discussed below, such behavior is important in understanding the role of commitment mechanisms more fully.

Bochet and Putterman (2004) examine a treatment condition with non-binding single-period promises to allocate a certain amount to the group account before each round. They find that group-account allocations are not significantly increased relative to control experiments unless subjects also have the ability to sanction each other. However, similar to the results of this chapter, Bochet and Putterman (2004) also find that non-binding promises lead to a larger dispersion of outcomes across groups than in control experiments. Moreover, comparing average group allocations between groups in the control experiments and those in the treatment experiments, they find that those groups with the highest group allocations and those with the lowest group allocations are observed in the condition with non-binding numerical promises.

Other studies have employed some aspect of a "real time" public goods environment developed by Dorsey (1991). In Dorsey's "real time" VCM

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<sup>32</sup> See Chen (1996) for further discussion of similar experiments.

environment, a decision round begins with subjects simultaneously making individual allocation decisions to the group account. The decision round continues for a publicly announced time interval. During this time, subjects are able to adjust their group-account allocation, with adjustments becoming public information. In the *increase only* treatment subjects can only increase their group allocation. In the *increase/decrease* treatment, subjects can either increase or decrease their allocation. In the *increase only* treatment, group-account allocations increase relative to the allocations observed in control experiments, and allocations do not tend to decay across decision rounds. In the *increase/decrease* treatment, group allocations tend to rapidly decay over time.<sup>33</sup>

Kurzban and Houser (2001) study a variation of Dorsey's environment they refer to as a "circular" public goods game. At the beginning of each decision round, subjects make a simultaneous allocation of tokens between their private and group accounts. Subsequently, one subject at a time is informed of the aggregate group allocation and given the option of changing their allocation. Each round ends at a randomly chosen end-point unknown to the subjects. At the end of each round, payoffs are determined by the final allocation of tokens to the group and private accounts. Kurzban and Houser find that some groups in this environment are able to achieve substantial levels of cooperation over a large number of rounds, without encountering the decay in contributions that often occurs in the repeated VCM.<sup>34</sup>

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<sup>33</sup> Kurzban, McCabe, Smith, and Wilson (2001) find similar results in a study using Dorsey's "real time" environment.

<sup>34</sup> Duffy et al. (2004) also examine a dynamic voluntary contribution game in which subjects act sequentially. Their study finds similar results.

### 3. Experimental Design

A total of 23 decision-making groups, comprised of 92 participants recruited from Indiana University undergraduate economics courses, were studied. Eighteen four-person groups participated in nine experimental sessions conducted in spring 2004 in the Interdisciplinary Experimental Laboratory at Indiana University, using software developed on the NovaNET computer network. Of these, ten groups participated in the treatment condition that allowed for multi-round commitments (from now on referred to as MRC) and eight groups participated in the control experiments without commitments. In addition, data is used from five four-person groups from a previous study by Laury, Walker, and Williams (1995) that used the same VCM procedures and parameters as the control experiments. This yields a total of thirteen control experiments.

The VCM procedures implemented in both the MRC and the control experiments are based on those used by Isaac, Walker, and Williams (1994). The instructions were identical across experiments except for a one-page addition describing the multi-round commitment mechanism in the MRC experiments.<sup>35</sup> Participants completed a sequence of 30 decision-making rounds. At the start of each round, individual  $i$  was endowed with  $Z_i$  tokens which were divided between a private account, earning a constant return of  $p_i$  per token, and a group account, earning a return based upon the total number of tokens allocated by the group. Tokens could not be carried across rounds. For a given round, let  $m_i$  represent individual  $i$ 's allocation of tokens to the group account and  $\sum m_j$  represent the sum of tokens placed

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<sup>35</sup> The experimental instructions are displayed in this chapter's Appendix A. The experimental data is presented in Appendix B.

in the group account by all other individuals ( $j \neq i$ ). Each individual earned  $[G(m_i + \sum m_j)]/N$  cents from the group account. Because each individual received a  $1/N$  share of the total earnings from the group account, the group account was a pure public good. The experiments were parameterized so that participants in groups of size  $N = 4$  were each endowed with 40 tokens per round. The return from each individual's private account was 1 cent per token. Defining the marginal per-capita return from the group account (MPCR) as the ratio of benefits to costs for moving a single token from the private account to the group account, or  $G'(\cdot)/N$ , the group account earned 2.2 cents per token allocated, yielding an  $MPCR = 0.55$ .

The return from the private account, and the function  $G(\cdot)$  were chosen so that the Pareto Optimum (the outcome that maximizes group earnings) was for each individual to place all tokens in the group account. However, under the assumption of individual earnings maximization and common information, the Nash equilibrium was for each individual to place zero tokens in the group account.

Each individual was informed of the number of rounds, their token endowment, the group's aggregate token endowment, and the returns from the private and group accounts. Subjects also knew that they would be randomly assigned to groups of size 4 and would remain in those groups for the duration of the experiment. It was explained that the decisions for each round were binding and that end-of-experiment earnings would be the sum of individual earnings from all rounds. Prior to the start of each round, participants were shown information on their own earnings for the previous round as well as the total number of tokens placed by the entire group in the group account. During each round, subjects could view their personal token

allocations, earnings, and total tokens placed in the group account for all previous rounds.

Prior to the 1st, 6th, 11th, 16th, 21st, and 26th round of the MRC experiments, subjects were given the option of making a binding 5-round commitment.<sup>36</sup> The aggregate group commitment of tokens to the group account was made public. Subjects were shown both their individual commitment and the aggregate group commitment on the computerized display used for eliciting their allocation decision in each round.

#### **4. Conjectures**

Under the assumption that all subjects act to maximize earnings and this is common knowledge, the unique subgame perfect Nash equilibrium in the game studied here is zero allocations to the group account. The addition of opportunities to make binding multi-round commitments does not change this prediction.

Building on the discussion presented in Bochet and Putterman (2004), suppose some subjects follow norms of behavior in which they prefer to cooperate when they believe others are cooperating, and to be less cooperative when they believe that others are not cooperating. These subjects would have utility based upon their monetary earnings as well as a reciprocity component. Finally, assume subjects begin with prior beliefs about the prevalence of reciprocating subjects. In this case, the repeated VCM game becomes a Bayesian game of the type analyzed in Kreps et al. (1982) in which subjects adjust their choices as they update their prior beliefs about others as the game progresses.

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<sup>36</sup> If a subject tried to make a group account allocation smaller than his commitment within any particular round, the subject received a message that he was in violation of his commitment and was prompted to reenter his allocation to the group account.

Many types of alternative preferences have been suggested to explain positive group allocations in VCM experiments, for example unconditional altruism, or individuals that receive a “warm glow” from giving. We have chosen to focus on reciprocity because it is best suited to explaining the dynamics of contributions across rounds in our experiment. Also, past research has indicated that reciprocity has more predictive power than altruism related theories. Similar to other studies, Croson (1999) finds that group-account allocations are significantly positively related to both the group allocations of other subjects, and to beliefs about those allocations, providing strong support for reciprocity theories.

In the control experiments, in the presence of reciprocating subjects, a group may be able to sustain significant levels of cooperation across rounds if large group-account allocations made in the first round are reciprocated in future rounds, as observed in Gunnthorsdottir et al. (2005). On the other hand, if subjects are paired with individuals who make low initial allocations to the group account, reciprocity may lead to decay in group allocations across rounds, as is often observed in finitely repeated VCM experiments. Clearly, a similar result could be observed if some subjects do not follow norms of reciprocity and do not reciprocate the positive group allocations of other group members.

Binding multi-round commitment opportunities may have implications for reciprocal behavior. Subjects have more reliable information about the future behavior of the other subjects in their group, and importantly, about the extent to which cooperative behavior can be exploited in future rounds. Further, binding commitments allow subjects to make more public their intentions toward cooperation.

A reciprocating subject may signal intentions to be cooperative by making a large commitment, and if large commitments by other group members are observed, the subject may reciprocate by increasing his group-account allocation above his commitment. This process could potentially continue in future rounds in which new commitments are solicited, leading to sustained high levels of cooperation. However, if a reciprocating subject encounters commitments by others that are small compared to his own, the subject may respond by making no group allocations above his commitment, and by decreasing his commitment at the next opportunity. Following this logic, in the presence of reciprocators, the following outcomes may be supportable.

- In both control and MRC experiments, when a subject encounters group allocations by other group members that are large relative to his own, he will increase his group allocation in the following round, and when a subject encounters group allocations small relative to his own, he will decrease his group allocation in the following round.
- In MRC experiments, a subset of subjects will be observed making positive commitments. Further, a subject will increase his allocation above his commitment by a larger amount when encountering commitments by other group members that are large relative to his own, and will increase his allocation above his commitment less when encountering commitments by other group members that are small relative to his own.
- In MRC experiments, a subject will increase his current commitment above his prior commitment in the previous 5-round commitment block if the

commitments of other group members were large relative to his own in the previous block, and decrease his commitment below his commitment in the previous block if the commitments of other group members were small relative to his own in the previous block.

- Due to the fact that multi-round commitments allow subjects to acquire more reliable information about the future behavior of other group members than is possible in the control experiments, a larger dispersion of outcomes across groups will be observed in the MRC experiments than in the control experiments. High levels of cooperation may be more easily maintained in the MRC experiments, while low levels of cooperation may be more extreme.

## 5. Results

The empirical analysis begins by considering aggregate allocations in the MRC and control experiments. This analysis is followed with a more detailed focus on individual behavior in both the MRC and control experiments. The final results turn to an examination of the variation of within-group and across-group behavior in the MRC and control experiments.

### *5.1 Group-Account Allocations across Treatment Conditions*

**Result 1.** Average group-account allocations across rounds are similar in the MRC and control experiments. However, the decay in the average group-account allocation observed in the control experiments is not evident in the MRC experiments.

Figure 9 displays average group-account allocations for each round in the MRC experiments and the control experiments. Behavior in the control experiments is similar to behavior in similarly parameterized linear public goods experiments.

Average group-account allocations decay from 53.32% in the first round to 29.76% in

the final round. This change is statistically significant.<sup>37</sup> Consistent with previous studies decay is not monotonic across rounds.

In the MRC experiments, the average group-account allocation pooled across all rounds is 45.77% of endowment. In the control experiments it is 45.83%. A t-test and a Wilcoxon test confirm that the average difference in group-account allocations is not significantly different.<sup>38</sup> However, as one can observe from Figure 9, there is an interesting difference in the behavior across decision rounds in the MRC experiments relative to the control experiments. In early rounds, average group-account allocations are actually higher in the control experiments. However, unlike the control experiments, average group-account allocations do not decay across rounds in the MRC experiments. In fact, average group-account allocations are higher in the last round of the MRC experiments, 47.25%, than in the first round, 42.31%.<sup>39</sup> Clearly, we cannot conclude that group-account allocations decline as rounds advance in the MRC experiments. By the last three rounds of the experiments, the average group-account allocations in the MRC experiments are well above those in the control experiments, although the difference is not statistically significant.

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<sup>37</sup> Matched pairs t-test ( $p = 0.020$ ), matched pairs Wilcoxon test ( $p = 0.034$ ), observations for 13 groups in each round.

<sup>38</sup> t-test ( $p = 0.977$ ), Wilcoxon-test ( $p = 0.904$ ), 390 observations in control experiments, 300 observations in MRC experiments.

<sup>39</sup> Matched pairs t-test ( $p = 0.629$ ), matched pairs Wilcoxon-test ( $p = 0.922$ ), 10 observations per round.

## *5.2 Prevalence of Commitments in MRC experiments*

**Result 2.** Subjects on average make positive commitments at each opportunity and there is no sign of decay in average commitments. A large portion of group allocations are pre-committed in every round.

Figure 10 displays the average commitment of tokens for each round, and the average group-account allocation in each round of the MRC treatment. Commitments average between 25% and 33% of endowments.<sup>40</sup> Further, there is no noticeable decay in average commitments. In fact, average commitments are highest at the final opportunity before round 26. The large variation of individual commitment decisions is a second general feature of the data. Figure 11, which displays the distribution of individual commitments pooled across the 6 commitment blocks illustrates. Less than 14% of individual commitments are for zero tokens. On the other hand, over 80% of commitments are for 50% or less of the token endowment. The average individual commitment when pooling across all commitment opportunities, is 27.72% of the token endowment, the median is 25% of the endowment.

Returning to the aggregate treatment results shown in Figure 10, observe that more than 50% of total group allocations in every round are pre-committed. A maximum of 71% of group allocations are pre-committed in round 1.

## *5.3 Evidence of Reciprocity in MRC and Control Experiments*

To examine the extent of reciprocity, I investigate how individuals respond to deviations from the behavior of other group members in the case of both group allocations and commitments. I begin with analysis of the MRC experiments, and conclude with analysis of the control experiments.

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<sup>40</sup> The size of commitments in percentage terms observed in the MRC experiments are consistent with the results observed in the previously referenced Chen and Komorita (1994) study on single-round commitments.

**Result 3.** In the first round of each commitment block of the MRC experiments, a subject makes his additional group-account allocation above his commitment larger or smaller in response to the deviation of his commitment from the mean commitment of other group members.

Define  $A_{ijt1}$  as individual  $i$ 's allocation to the group  $j$  group account in round 1 of block  $t$ , and  $C_{ijt}$  as  $i$ 's commitment to the group  $j$  group account in block  $t$ . Then, the additional group allocation a subject makes above his commitment in round 1 of block  $t$  can be defined as  $\Delta AC_{ijt1} = A_{ijt1} - C_{ijt}$ . Further, define  $\bar{C}_{-ijt}$  as the mean commitment of other group  $j$  members in block  $t$ . The deviation of a subject  $i$ 's commitment from the mean commitment of other group  $j$  members can then be defined as  $\Omega C_{ijt} = C_{ijt} - \bar{C}_{-ijt}$ .

Table 14 displays estimates of the following subject specific random effects model:

$$\Delta AC_{ijt1} = \beta_o + \beta_c \Omega C_{ijt} + \beta_B \text{BLOCK} + \sum_{j=2}^{10} \beta_{gj} D_j + u_i + \varepsilon_{ijt1}$$

BLOCK is the commitment block number added to the regression to control for intertemporal effects. Dummy variables,  $D_j$ , for experimental groups 2 through 10 are also added. A Tobit specification is used for estimation purposes because  $\Delta AC_{ijt1}$  is bounded from below at 0.

Providing strong evidence for reciprocity,  $\beta_c$  is negative and strongly significant. The estimated marginal effect of -.281 for the  $\beta_c$  coefficient reflects a strong tendency for participants to reciprocate commitment decisions with group-account allocation responses. When their commitments are less than the average commitment of others, individuals tend to choose larger additional group-account allocations in the first round of each block. When individuals commit more than the

average commitment of others, they tend to choose smaller additional group-account allocations in round 1 of each block. Also, the sign of  $\beta_B$ , the commitment block coefficient, is negative, meaning that as commitment blocks advance, subjects tend to increase group-account allocations above commitments less.<sup>41</sup>  $\beta_B$  is marginally statistically significant.

**Result 4.** In rounds 2 through 5 of each 5 round commitment block, a subject makes his additional group-account allocation above his commitment larger or smaller in response to the deviation of his commitment from the mean commitment of other group members. At the same time, a subject responds reciprocally to how much other members of his group increased their group-account allocations above their commitments in the previous round.

Define  $A_{-itjk-1}$  as the total amount other group  $j$  members besides subject  $i$  allocated to the group account in round  $k-1$  of commitment block  $t$ , and  $C_{-itjk-1}$  as the total commitment of other group  $j$  members besides subject  $i$  in round  $k-1$  of commitment block  $t$ . Then,  $\Delta AC_{-itk-1} = A_{-itjk-1} - C_{-itjk-1}$  is the total amount that other group  $j$  members besides subject  $i$  increased their group-account allocations above their commitments in round  $k-1$  of block  $t$ . Table 15 displays Tobit estimates of the following regression model with subject specific random effects:

$$\Delta AC_{ijk} = \beta_o + \beta_c \Omega C_{ijk} + \beta_{Ac} \Delta AC_{-itk-1} + \beta_B BLOCK + \sum_{j=2}^{10} \beta_{gj} D_j + u_i + \varepsilon_{ijk}$$

The index on round,  $k$ , can take the values of 2 through 5, as there are 5 rounds in each commitment block, and in the case of the dependent variable, data from the first round is omitted.

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<sup>41</sup> Regressions were also performed using separate dummy variables for each block instead of the commitment block number, with similar results.

$\beta_c$  is negative and strongly significant with a marginal effect of -0.383.

Therefore, similar to result 3, when their commitments are less than the average of the commitments of others, individuals tend to offer larger additional group-account allocations, and when individuals commit more than the average commitment of others, they tend to offer smaller additional group-account allocations. At the same time,  $\beta_{Ac}$  is positive and statistically significant with a marginal effect of 0.122, meaning that the more that other group members increased their group-account allocations above their commitments in the previous round, the more a subject increases his group-account allocation above his commitment in the current round.

$\beta_B$  is negative and statistically significant in this case, meaning that as commitment blocks advance, subjects tend to increase group-account allocations above commitments less.

**Result 5.** In the MRC experiments, subjects adjust their commitments at each opportunity in response to the difference between their previous commitment and the average previous commitment of other group members, and in response to how much other group members increased their group allocations above their commitments in the previous commitment block.

Define  $\Delta C_{ijt} = C_{ijt} - C_{ijt-1}$  as the difference between subject i's commitment in block t and his commitment in block t-1. Secondly, define  $\overline{\Delta AC}_{-ijt-1}$  as the total amount that other group j members besides subject i increased their group-account allocations above their commitments averaged over the previous 5 round commitment block. Table 16 displays GLS estimates of the following regression model with subject specific random effects:

$$\Delta C_{ijt} = \beta_o + \beta_c \Omega C_{ijt-1} + \beta_{Ac} \overline{\Delta AC}_{-ijt-1} + \beta_B \text{BLOCK} + \sum_{j=2}^{10} \beta_{gj} D_j + u_i + \varepsilon_{ijt}$$

GLS estimates are used because in this case the dependent variable is not bounded from below at zero.  $\beta_c = -0.458$  is negative and significant, implying that the larger the positive deviation of a subject's commitment from the average commitment of others in the previous commitment block, the less a subject increases his current commitment above his previous commitment. Also,  $\beta_{Ac} = 0.124$  is positive and significant, implying that the more that other group members increased their group-account allocations above their commitments over the five rounds of the previous commitment block, the more subjects tend to raise their commitments relative to the previous commitment opportunity. In this case the sign of  $\beta_B$  is positive, and weakly statistically significant.

The following analysis turns to an examination of individual behavior in the control experiments. In particular, the analysis examines the extent to which changes in subjects' group allocations across decisions rounds can be linked to the past decisions of other group members.

**Result 6.** In the control experiments, subjects reciprocate group allocation decisions in round k-1 with larger or smaller group allocations in round k.

Table 17 displays GLS estimates of the following regression model with subject specific random effects:

$$\Delta A_{ijk} = \beta_A \Omega A_{ijk-1} + \beta_R ROUND + \sum_{j=2}^{13} \beta_{gj} D_j + u_i + \varepsilon_{ijk}$$

The dependent variable,  $\Delta A_{ijk} = A_{ijk} - A_{ijk-1}$ , is the difference between subject i in group j's group-account allocation in round k and his group-account allocation in round k-1.  $\Omega A_{ijk-1} = A_{ijk-1} - \bar{A}_{-ijk-1}$  is the difference between subject i's group-account

allocation in round  $k-1$  and the average group-account allocation of the other members of subject  $i$ 's group in round  $k-1$ . ROUND is the round number added to the regression to control for intertemporal effects.

The results indicate that in the control experiments, subjects tend to increase their group-account allocation above their previous group-account allocation if their group-account allocation was below the average of other group members' allocations in the previous round, and to decrease their group-account allocation if their group-account allocation was above the average of other group members allocations in the previous round.  $\beta_A$  is negative and strongly significant. The coefficient on round number,  $\beta_R$ , has a negative sign, but is not statistically significant.<sup>42</sup>

The analysis that relates to the final two results is designed to examine to what extent the dispersion of within-group individual behavior and across-group behavior varies between the MRC and control experiments.

#### *5.4 Across-Group Dispersion in Group-Account Allocations*

**Result 7.** Less variation in individual allocations to the group account is observed within groups in the MRC experiments than in the control experiments.

Within each decision round and each group, one can compute the standard deviation of individual allocations to the group account. Figure 12 displays the average within-group standard deviation for the MRC and the control experiments. With the exception of the first five rounds, and the final five rounds, the average within-group standard deviation is smaller in the MRC treatment. This difference in average within-group standard deviations is statistically significant when pooling

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<sup>42</sup> Regressions were performed using separate dummy variables for each round instead of the round number, with similar results.

across rounds (two sample t-test and Wilcoxin two sample test,  $p=0.000$ ). This observation suggests that the commitment mechanism, by providing additional information, may have allowed individuals in each group to more closely reciprocate, and conform to the behavior of other group members.

**Result 8.** A larger variance in group outcomes is observed in the MRC experiments than the control experiments.

Earlier discussion conjectured that multi-round commitments may allow subjects to acquire more reliable information about the future behavior of other group members than is possible in the control experiments. This may create a larger dispersion of allocations to the group account across groups in the MRC experiments relative to the control experiments. To investigate this possibility, we separate groups in the MRC and control experiments into two categories; those groups with an average group-account allocation higher than the overall average of groups in their treatment condition, "high groups", and those with a lower average group-account allocation, "low groups".

Figure 13 displays the average difference between high groups and low groups in the MRC experiments and the average difference between high groups and low groups in the control experiments. The results are quite striking. The average difference between the high and low groups is larger for the MRC experiments than for the control experiments in the vast majority of rounds. This result is largely driven by the behavior of low groups in the MRC treatment; in 27 of 30 rounds the average allocation to the group account is smaller in the MRC low groups than in the control low groups. In contrast, there is frequent overlap in the average allocation to the group account when comparing the high groups of the MRC and control

experiments, although in late decision rounds the average group-account allocation in the high MRC groups tends to be above the average in the control experiments.

Figure 14 provides further evidence in support of Result 8. Figure 14 displays average commitments and average group-account allocations for an example high group and an example low group from the MRC experiments. It is quite apparent that the maintenance of cooperative outcomes is enhanced by increasing commitments as rounds advance in the high group. While in the low group, average commitments decrease across rounds, as do average group-account allocations.

## **6. Conclusions**

This chapter examines the effects of allowing binding multi-round commitments of tokens to the group account in a repeated voluntary contributions mechanism (VCM) game. Subjects make binding commitments averaging between 25% and 33% of their endowments. However, total group-account allocations are not systematically greater on average in the MRC experiments than those observed in the control experiments. Although, in the final decision rounds, average group-account allocations in MRC experiments tend to be higher than the control experiments, due to the lack of decay in group allocations in the MRC treatment.

The study finds strong evidence of subjects following norms of reciprocity in the MRC experiments. Subjects respond reciprocally to other subjects when deciding how large to make a commitment before each commitment block, and also when deciding how much to increase their group-account allocation above their commitment in each round. Evidence for reciprocity was also found in the control experiments as group-account allocations responded to decisions in prior rounds.

The results of this chapter are largely consistent with Bochet and Putterman (2004) which studies non-binding numerical promises in the VCM. While binding multi-round commitments have little effect on the average level of group-account allocations relative to the control experiments, commitments appear to promote more homogeneity within groups as subjects respond to commitments in a reciprocal manner. Further, there is a larger variance of group outcomes in the MRC experiments relative to the control experiments, leading to patterns of group cooperation that are more extreme.

**Tables**

*Table 14.* Reciprocity and Group-Account Allocations – First Round of Each Commitment Block

N = 240      Individuals = 40						
Dependent Variable: $\Delta AC_{ijt1}$						
	Coefficient	S.E.	p	Marginal Effect	S.E.	p
$\Omega C_{ijt}$	-0.522	0.127	0.000	-0.281	0.068	0.000
BLOCK	-0.748	0.395	0.058	-0.402	0.233	0.084
Constant	7.667	2.333	0.001	4.123	1.645	0.012
GROUP 2	-5.435	2.973	0.068	-2.922	1.690	0.084
GROUP 3	-6.951	5.054	0.169	-3.738	2.639	0.157
GROUP 4	-1.838	9.432	0.846	-0.988	5.035	0.844
GROUP 5	-0.206	6.026	0.973	-0.112	3.234	0.973
GROUP 6	6.699	11.697	0.567	3.602	6.723	0.592
GROUP 7	-9.806	2.863	0.001	-5.273	1.868	0.005
GROUP 8	-12.587	4.105	0.002	-6.768	2.547	0.008
GROUP 9	-6.426	4.601	0.163	-3.455	2.486	0.165
GROUP 10	-4.998	16.934	0.768	-2.687	8.744	0.759
Log Likelihood = -574.380						

Note:  $\Delta AC_{ijt1} = 0$  for 103 observations.

Table 15. Reciprocity and Group-Account Allocations – Rounds 2-5 of Each Commitment Block

N = 960    Individuals = 40						
Dependent Variable: $\Delta AC_{ijk}$						
	Coefficient	S.E.	p	Marginal Effect	S.E.	p
$\Omega C_{ijk}$	-0.569	0.034	0.000	-0.383	0.036	0.000
$\Delta AC_{-itk-1}$	0.182	0.028	0.000	0.122	0.016	0.000
BLOCK	-0.416	0.150	0.006	-0.281	0.101	0.006
Constant	6.951	2.200	0.002	4.679	1.540	0.002
GROUP 2	-2.919	2.980	0.327	-1.965	1.998	0.326
GROUP 3	-4.293	4.076	0.292	-2.890	2.693	0.283
GROUP 4	-2.455	3.526	0.486	-1.653	2.345	0.481
GROUP 5	-3.523	3.772	0.350	-2.378	2.511	0.344
GROUP 6	0.996	4.667	0.831	0.671	3.157	0.832
GROUP 7	-9.560	3.953	0.016	-6.435	2.586	0.0128
GROUP 8	-14.634	5.761	0.011	-9.851	3.562	0.006
GROUP 9	-8.735	3.610	0.016	-5.880	2.392	0.014
GROUP 10	-3.132	3.794	0.409	-2.108	2.529	0.405
Log Likelihood = -2578.910						

Note:  $\Delta AC_{ijk} = 0$  for 341 observations.

Table 16. Reciprocity and Commitments

N = 200		Number of Individuals = 40	
Dependent Variable: $\Delta C_{ijt}$			
	Coefficient	S.E.	p
$\Omega C_{ijt-1}$	-0.458	0.053	0.000
$\overline{\Delta AC}_{ijt-1}$	0.124	0.044	0.002
BLOCK	0.772	0.315	0.014
Constant	-7.334	2.996	0.014
GROUP 2	1.381	2.896	0.634
GROUP 3	-0.115	2.965	0.969
GROUP 4	-0.150	2.931	0.959
GROUP 5	2.040	2.918	0.485
GROUP 6	2.066	2.853	0.469
GROUP 7	1.073	3.068	0.727
GROUP 8	3.114	3.206	0.803
GROUP 9	0.763	3.049	0.803
GROUP 10	2.951	2.957	0.318
$R^2 = 0.244$			

Table 17. Reciprocity in Control Experiments

N = 1508		Number of Individuals = 40	
Dependent Variable: $\Delta A_{ijk}$			
	Coefficient	S.E.	p
$\Omega A_{ijk-1}$	-0.535	0.022	0.000
ROUND	-0.025	0.033	0.454
Constant	-0.306	1.980	0.877
GROUP 2	0.190	2.696	0.944
GROUP 3	0.345	2.696	0.898
GROUP 4	-0.181	2.696	0.947
GROUP 5	-0.198	2.696	0.941
GROUP 6	0.784	2.696	0.771
GROUP 7	0.793	2.696	0.769
GROUP 8	0.888	2.696	0.742
GROUP 9	0.448	2.696	0.868
GROUP 10	0.983	2.696	0.716
GROUP 11	-0.241	2.696	0.929
GROUP 12	0.448	2.696	0.868
GROUP 13	0.707	2.696	0.793
$R^2 = 0.203$			

**Figures**

Figure 9. Average Group-Account Allocations: MRC and Control Experiments

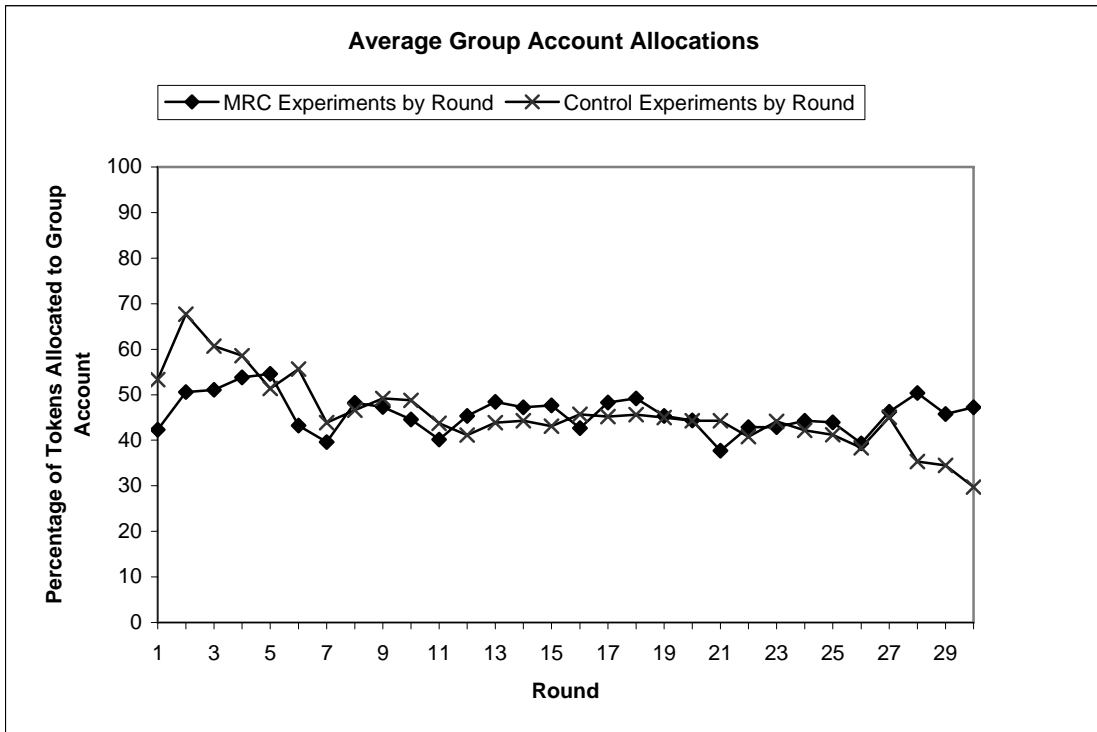


Figure 10. Average Individual Commitments and Group-Account Allocations: MRC Experiments

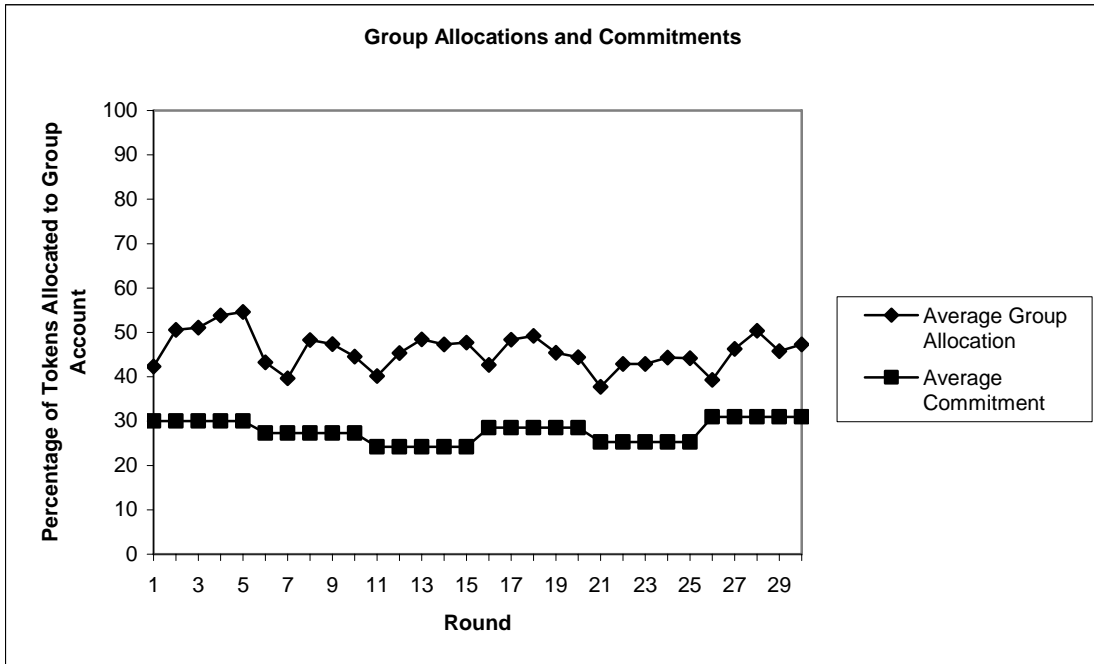


Figure 11. Distribution of Individual Commitments

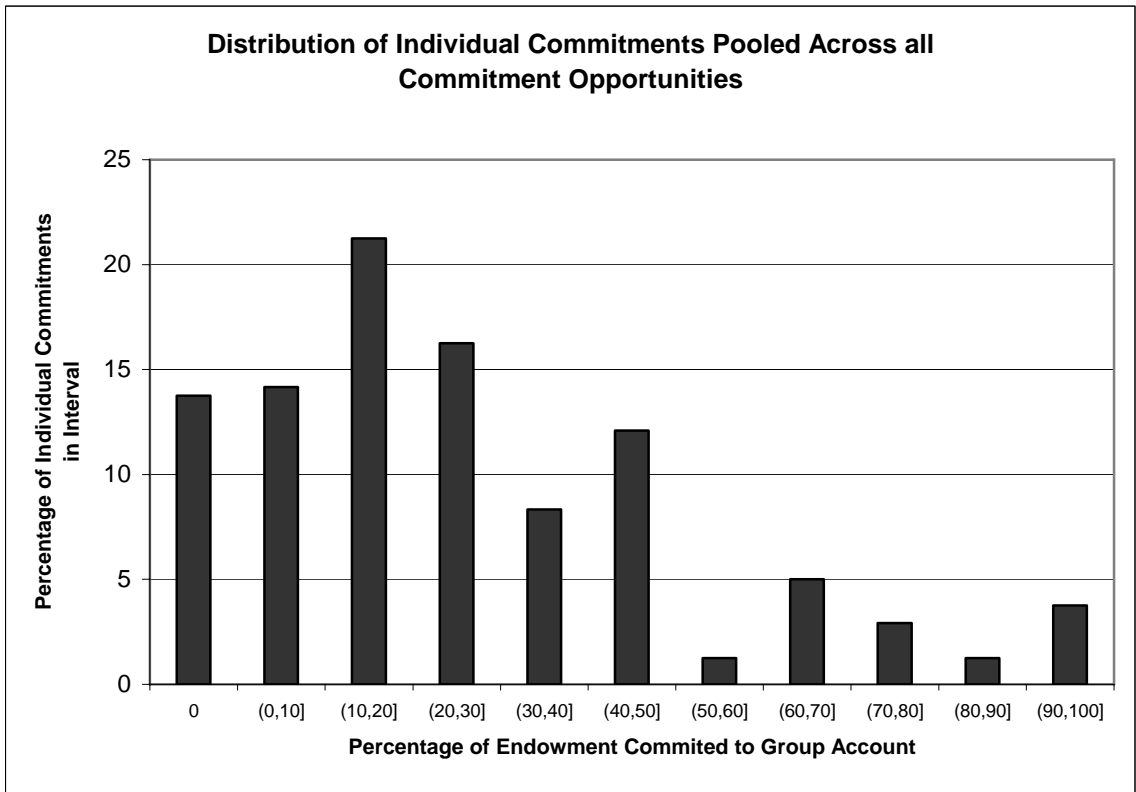


Figure 12. Within-Group Standard Deviations of Individual Group-Account Allocations

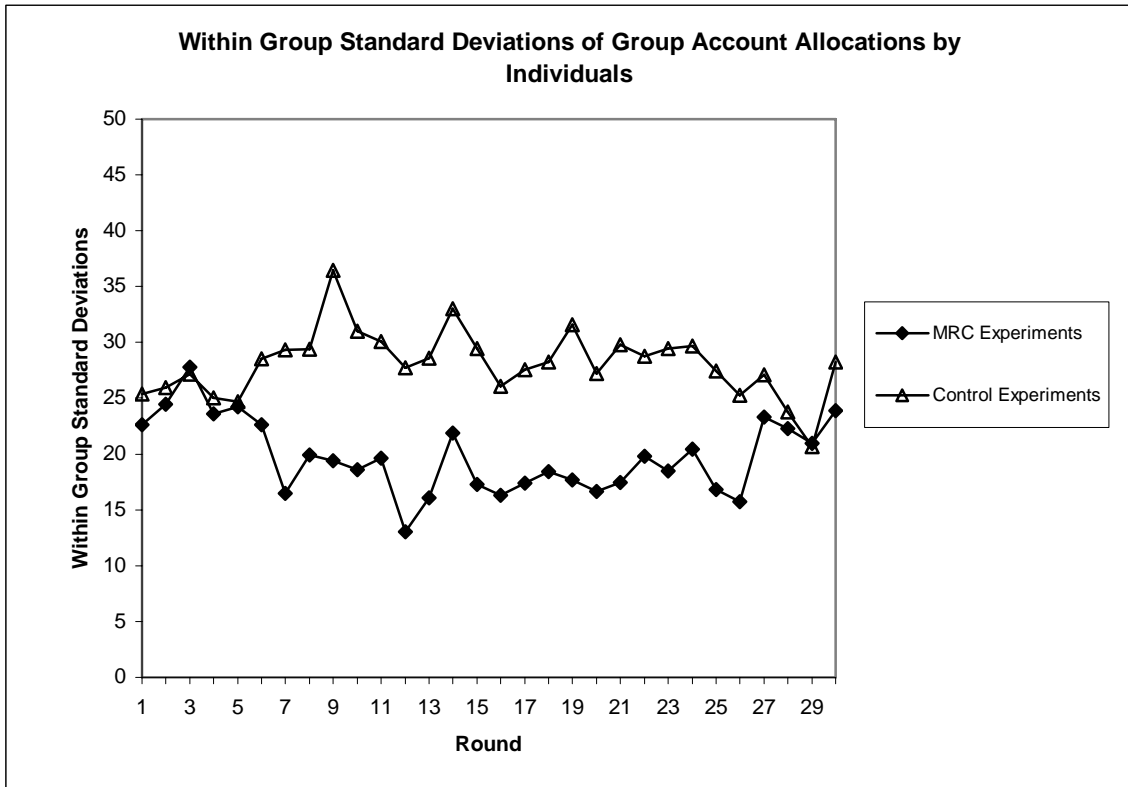


Figure 13. Differences in Average Group Allocations: High Groups and Low Groups

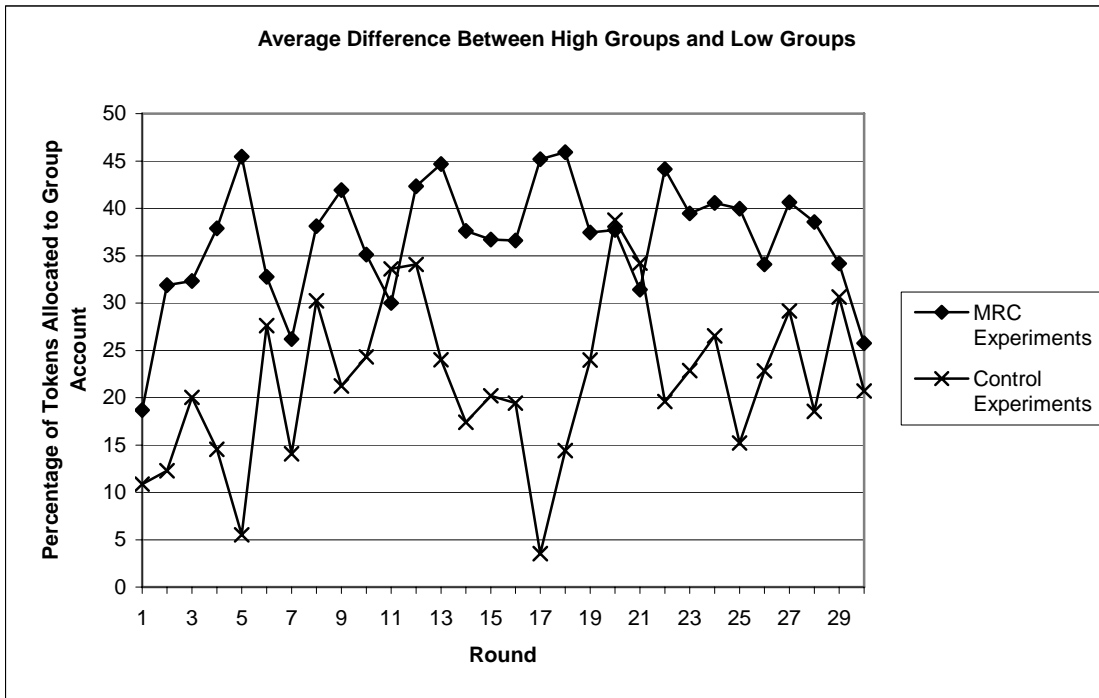
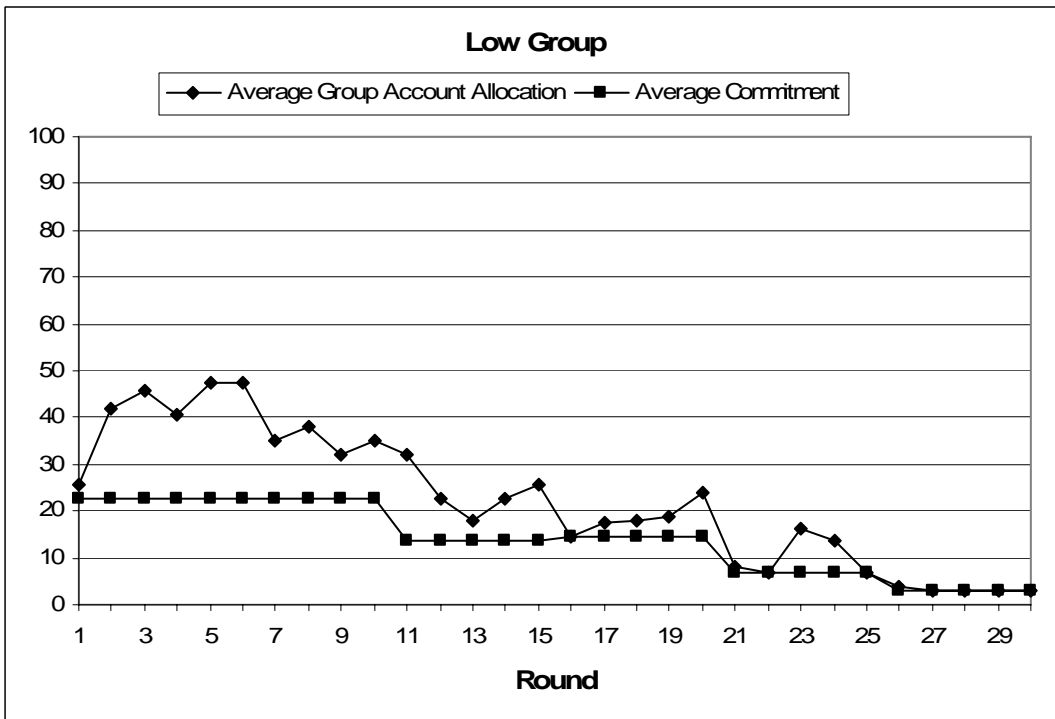
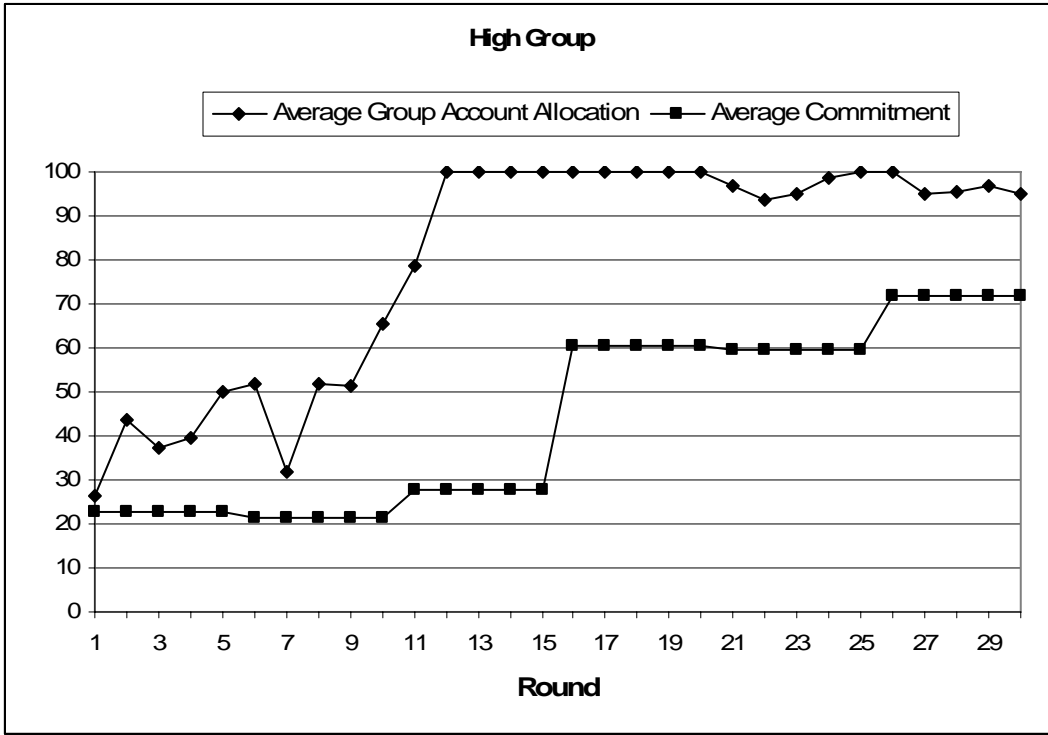


Figure 14. Group-Account Allocations and Commitments in MRC Experiments – Example High Group and Example Low Group



## CHAPTER 4 - APPENDIX A - EXPERIMENTAL INSTRUCTIONS

These instructions are copied from sequential interactive NovaNet displays. The instructions are presented to the subjects in a sequential manner - paragraph by paragraph. Subjects are able to review prior information at any time.

The fifth page of instructions was only included in the instructions for the MRC experiments, subjects in the control experiments only saw the first four pages.

### **1st Page:**

This is an exercise in the economics of group decision making. When you logged into the exercise for the first time, you were randomly assigned to a particular group along with 3 other people.

The exercise will occur over a sequence of 30 decision-making rounds. At the start of each round you will be endowed with 40 "tokens". In each round, you must decide how to divide your tokens between your "PRIVATE ACCOUNT" and a "GROUP ACCOUNT". Each person in the group has a Private Account, however, there is only one Group Account for the entire group.

Press -NEXT- to continue.

### **2nd Page:**

You will earn \$ 0.01 for each token that you retain in your PRIVATE ACCOUNT in any decision-making round. Thus, if you choose to retain all of your 40 tokens in your private account you will earn \$ 0.40 in that round from your private account.

Everyone in the group will receive the same portion of the earnings from the GROUP ACCOUNT. Thus, if 4 people are in your group, you will receive  $1/4 = 25\%$  of the group earnings from the group account regardless of the number of tokens that you place in the group account.

It is important to realize that EVERYONE in the group receives a  $1/4$  share of the earnings from the group account. This is true for each individual regardless of the number of tokens that the individual places in the group account.

Press -NEXT- to continue or -BACK- to review.

### 3rd Page:

Here is a table that shows how both group earnings and your individual earnings from the group account will vary with the number of tokens placed in the group account. This table will be displayed on your viewing screen during each round of the exercise.

Examples of possible earnings from the GROUP ACCOUNT

Tokens in GROUP ACCOUNT (from the entire group)	Total Group Earnings	Your 25% share of Group Earnings
0	\$ 0.000	\$ 0.000
10	\$ 0.220	\$ 0.055
20	\$ 0.440	\$ 0.110
30	\$ 0.660	\$ 0.165
40	\$ 0.880	\$ 0.220
50	\$ 1.100	\$ 0.275
60	\$ 1.320	\$ 0.330
70	\$ 1.540	\$ 0.385
90	\$ 1.980	\$ 0.495
100	\$ 2.200	\$ 0.550
110	\$ 2.420	\$ 0.605
120	\$ 2.640	\$ 0.660
130	\$ 2.860	\$ 0.715
140	\$ 3.080	\$ 0.770
150	\$ 3.300	\$ 0.825
160	\$ 3.520	\$ 0.880

The first row in the table indicates that the MINIMUM number of tokens that can be placed in the group account is 0. This will occur if everyone in the group places no tokens in the group account and will result in group earnings from the group account of \$0.

The last row in the table indicates that the MAXIMUM number of tokens that can be placed in the group account is 160. This is the summation of the individual token endowments for the entire group and would result in group earnings from the group account of \$3.52.

The table reveals that for token 1 through token 160 placed in the group account, total group earnings from the group account increase by \$0.022 per token. Thus, each individual's earnings from the group account increase by  $\$0.022 / 4 = \$0.0055$  per token over this range.

The information that just appeared above the table will appear on your display each round. You will also be able to see "Total Group Earnings" and "Your Share of Group Earnings" for any level of "Tokens in Group Account" not already displayed in the table. You will be able to access this option by pressing the -LAB-key.

Prior to entering your decisions for rounds 2 - 30 you will be shown the results from the previous round. You will also be able to review the results from ANY previous round by pressing the -DATA- key.

You will be able to review the instructions prior to making your decision in any round by pressing the -HELP- key.

#### **4th Page:**

In order to make sure that you understand how each round will proceed, let's work through an instructive example of the decision entry process that you will go through each round.

INSTRUCTIVE EXAMPLE ONLY -- this is the question that you will be asked during each round of the exercise. Type in a number and then press -NEXT-.

How many tokens do you wish to place in the GROUP ACCOUNT? ? 23

After pressing -NEXT-, you must confirm your entry by pressing -STOP-. Your entry will then be stored permanently in the database for your group. If you make a typing error or change your mind, press -BACK-.

Tokens to GROUP ACCOUNT: 23 -- Tokens to PRIVATE ACCOUNT: 17  
-STOP- confirm these decisions.  
-BACK- start over.

You know that you will earn  $\$ 0.01 * 17 = \$ 0.17$  from your PRIVATE ACCOUNT in this round. You do not know, however, how much you will earn from the GROUP ACCOUNT since you do not yet know how many tokens everyone else in the group will place in the group account.

The number of tokens placed by the entire group in the group account, your earnings from the group account, and your earnings from the private account will be reported to you prior to entering your decision for the next round.

Press -NEXT- to continue or -BACK- to review.

## 5th Page:

### Special Instructions for Today's Experiment

Before rounds 1, 6, 11, 16, etc. everyone in your group (including you) will be asked to enter a commitment of tokens allocated to the group account for each of the next 5 rounds. You may choose any number of tokens from 0 to 40 as your commitment. A commitment sets your minimum allocation to the group account for each of the next 5 rounds.

For example, if you choose  $X$  tokens as your commitment to the group account prior to round 1, you must place at least  $X$  tokens into the group account in each of rounds 1 through 5. You will then enter a new commitment of tokens to the group account (between 0 and 40) after round 5 is finished, but before round 6 begins. This new commitment will set your minimum allocation of tokens to the group account for each of the next 5 rounds (rounds 6 through 10).

After all commitment decisions have been entered, the total number of tokens committed to the group account will be displayed to everyone in the group. When you are prompted to enter your allocation decision in each round you will be shown your own commitment of tokens to the group account as well as the sum of the group's commitments to the group account, which will include your own personal commitment.

This is the end of the instructions.  
Press -NEXT- to enter the exercise.  
Press -BACK- to review the instructions.

## CHAPTER 4 - APPENDIX B - EXPERIMENTAL DATA

First, data from the 10 experimental groups that participated in the MRC experiment is presented. Secondly, data from the 13 experimental groups that participated in the control experiments is presented.

### 1. Multi Round Commitment (MRC) Experiments

Commitments are made before the 1st, 6th, 11th, 16th, 21st, and 26th rounds. All data is in tokens. At each commitment opportunity, the number shown is the number of tokens committed by the subject per round in each of the following five rounds. The data for each round is the total number of tokens allocated to the group account by the subject in that round. In each round, subjects have a forty token endowment.

	Group 1				Group 2			
	Subject 1	Subject 2	Subject 3	Subject 4	Subject 5	Subject 6	Subject 7	Subject 8
COM1	0	6	5	10	3	5	25	22
R1	30	8	5	11	8	5	25	25
R2	35	15	5	23	40	10	30	25
R3	35	21	10	27	3	20	35	30
R4	35	34	15	33	7	30	40	22
R5	35	30	20	39	22	30	40	30
COM6	0	7	8	30	14	25	20	20
R6	38	8	10	30	20	30	25	35
R7	38	20	8	30	14	25	30	20
R8	30	30	8	32	14	25	38	40
R9	30	35	8	30	26	35	30	38
R10	0	7	8	31	21	30	25	40
COM11	0	4	5	1	3	20	20	25
R11	30	5	5	4	9	20	20	30
R12	30	15	5	6	12	25	25	35
R13	30	25	5	8	40	30	20	25
R14	30	4	5	12	13	35	20	40
R15	5	20	5	6	17	25	20	40
COM16	8	5	10	3	18	20	10	10
R16	30	10	10	7	18	20	10	35
R17	30	30	10	9	25	30	15	38
R18	30	20	12	11	35	25	10	39
R19	30	16	10	9	18	30	10	10
R20	8	10	10	13	22	30	10	10
COM21	10	2	5	3	5	30	5	20
R21	25	9	5	7	20	30	5	30
R22	40	20	20	7	35	40	5	20
R23	40	25	30	13	7	40	5	35
R24	40	30	35	20	7	40	8	35
R25	40	10	10	14	24	40	8	40

	Group 1				Group 2			
	Subject 1	Subject 2	Subject 3	Subject 4	Subject 5	Subject 6	Subject 7	Subject 8
COM26	15	8	10	7	8	30	5	23
R26	25	15	10	11	9	30	8	23
R27	40	25	25	15	8	40	5	30
R28	40	30	20	17	8	30	10	23
R29	40	9	20	16	16	30	13	23
R30	15	9	25	11	8	30	15	30

	Group 3				Group 4			
	Subject 9	Subject 10	Subject 11	Subject 12	Subject 13	Subject 14	Subject 15	Subject 16
COM1	15	25	40	20	10	40	1	10
R1	20	35	40	22	13	40	5	13
R2	17	30	40	30	15	40	7	19
R3	15	25	40	40	15	40	1	20
R4	25	28	40	30	17	40	3	18
R5	20	35	40	39	10	40	3	24
COM6	10	30	20	25	0	10	1	12
R6	15	30	20	32	0	22	1	13
R7	17	30	20	25	15	18	10	13
R8	30	31	25	40	40	18	5	19
R9	18	35	40	40	20	25	7	25
R10	19	34	30	40	19	40	5	15
COM11	5	25	5	40	10	10	1	15
R11	10	25	15	40	19	18	5	17
R12	18	40	40	40	19	18	6	16
R13	25	34	40	40	22	18	7	15
R14	22	25	5	40	20	18	5	18
R15	24	31	20	40	30	30	3	18
COM16	18	20	15	40	10	10	1	16
R16	19	40	20	40	20	30	3	18
R17	20	35	15	40	30	18	2	21
R18	18	20	40	40	20	30	2	17
R19	19	25	15	40	25	18	1	19
R20	21	40	15	40	20	10	5	16
COM21	8	10	5	40	15	0	1	5
R21	10	10	5	40	15	0	40	12
R22	16	10	40	40	15	0	1	19
R23	18	15	5	40	25	18	5	13
R24	17	10	5	40	21	0	5	18
R25	20	20	5	40	21	18	3	17
COM26	18	5	1	40	20	0	1	11
R26	20	20	1	40	20	0	5	16
R27	18	40	1	40	20	0	3	17
R28	19	5	40	40	20	0	10	30
R29	18	5	15	40	20	0	5	16
R30	18	5	1	40	20	0	10	12

	Group 5				Group 6			
	Subject 17	Subject 18	Subject 19	Subject 20	Subject 21	Subject 22	Subject 23	Subject 24
COM1	10	40	6	20	5	3	20	8
R1	17	40	20	24	10	4	20	8
R2	20	40	25	25	12	30	20	8
R3	23	40	27	29	13	15	20	12
R4	20	40	31	27	12	18	20	13
R5	23	40	30	23	17	20	35	8
COM6	12	25	10	17	16	10	2	6
R6	15	30	30	20	16	40	5	22
R7	17	25	30	18	20	15	10	6
R8	20	30	20	17	16	22	15	30
R9	17	40	20	17	18	11	15	38
R10	20	25	32	19	20	35	20	30
COM11	10	20	25	17	17	10	2	15
R11	15	40	25	25	35	11	40	40
R12	17	20	28	27	40	40	40	40
R13	18	20	25	18	40	40	40	40
R14	23	30	25	17	40	40	40	40
R15	20	20	25	18	40	40	40	40
COM16	15	10	10	16	35	12	10	40
R16	20	20	12	20	40	40	40	40
R17	25	40	20	18	40	40	40	40
R18	25	40	22	18	40	40	40	40
R19	25	35	25	18	40	40	40	40
R20	22	35	30	18	40	40	40	40
COM21	18	20	15	16	35	30	10	20
R21	20	30	20	20	40	40	40	35
R22	25	40	18	20	40	40	40	30
R23	23	25	20	22	40	40	40	32
R24	18	23	22	20	40	40	40	38
R25	23	27	30	20	40	40	40	40
COM26	15	40	15	24	35	32	20	28
R26	25	40	25	24	40	40	40	40
R27	28	40	25	24	40	40	40	32
R28	23	40	27	30	40	40	40	33
R29	20	40	30	28	40	40	40	35
R30	18	40	32	32	40	40	40	32

	Group 7				Group 8			
	Subject 25	Subject 26	Subject 27	Subject 28	Subject 29	Subject 30	Subject 31	Subject 32
COM1	5	10	1	20	5	0	0	5
R1	10	10	1	20	5	0	0	20
R2	15	11	1	40	8	0	0	20
R3	20	12	1	40	10	0	0	40
R4	17	20	3	25	5	0	0	40
R5	15	30	1	30	5	0	0	5

	Group 7				Group 8			
	Subject 25	Subject 26	Subject 27	Subject 28	Subject 29	Subject 30	Subject 31	Subject 32
COM6	5	10	1	20	1	0	0	10
R6	15	40	1	20	1	1	0	10
R7	13	12	1	30	5	0	0	10
R8	15	20	1	25	1	0	0	10
R9	10	20	1	20	1	0	0	10
R10	15	20	1	20	1	1	0	10
COM11	1	10	1	10	1	0	0	0
R11	15	25	1	10	1	0	0	0
R12	10	15	1	10	1	0	0	0
R13	8	10	1	10	1	0	0	0
R14	5	20	1	10	1	0	0	10
R15	8	12	1	20	1	0	0	0
COM16	5	12	1	5	0	0	0	0
R16	5	12	1	5	1	0	0	0
R17	5	12	1	10	1	0	0	0
R18	6	12	1	10	0	0	0	0
R19	7	12	1	10	0	0	5	0
R20	7	15	1	15	5	0	0	5
COM21	5	0	1	5	0	0	0	0
R21	5	2	1	5	5	0	0	5
R22	5	0	1	5	1	0	0	5
R23	5	15	1	5	2	0	0	0
R24	6	0	1	15	0	0	0	0
R25	5	0	1	5	0	0	0	0
COM26	1	0	1	3	0	0	0	0
R26	1	1	1	3	1	0	0	0
R27	1	0	1	3	5	40	0	0
R28	1	0	1	3	1	40	0	20
R29	1	0	1	3	1	0	0	40
R30	1	0	1	3	1	40	0	0

	Group 9				Group 10			
	Subject 33	Subject 34	Subject 35	Subject 36	Subject 37	Subject 38	Subject 39	Subject 40
COM1	25	2	0	20	15	1	3	20
R1	30	3	40	25	15	15	15	20
R2	25	10	10	30	15	18	20	25
R3	30	5	5	20	15	18	10	35
R4	25	15	10	20	15	30	8	30
R5	25	5	0	30	15	12	7	40
COM6	15	5	0	10	5	5	5	15
R6	15	7	0	10	5	15	15	30
R7	15	5	0	15	5	19	10	20
R8	17	8	0	10	10	15	30	15
R9	15	5	0	10	10	5	15	17
R10	15	5	0	10	15	10	10	15

	Group 9				Group 10			
	Subject 33	Subject 34	Subject 35	Subject 36	Subject 37	Subject 38	Subject 39	Subject 40
COM11	10	2	0	5	15	7	10	10
R11	10	3	8	15	20	7	15	10
R12	10	5	3	15	15	10	13	15
R13	40	5	3	5	30	7	10	20
R14	40	10	0	15	20	7	10	40
R15	40	4	10	20	30	20	10	10
COM16	20	5	0	5	20	3	8	10
R16	20	5	0	20	20	4	8	20
R17	20	10	5	15	30	10	13	10
R18	25	7	0	15	30	7	25	15
R19	25	8	0	10	40	20	10	20
R20	30	5	0	10	30	6	11	25
COM21	5	6	0	5	25	5	5	15
R21	5	6	0	5	25	10	7	15
R22	5	6	0	5	30	7	20	15
R23	5	6	0	5	30	6	5	25
R24	40	6	0	5	30	12	7	15
R25	5	6	5	15	25	7	25	18
COM26	5	5	0	3	25	6	5	30
R26	5	5	0	10	30	10	5	30
R27	5	5	5	10	25	8	6	30
R28	5	8	10	5	25	25	7	40
R29	10	5	0	7	30	20	15	40
R30	40	7	10	5	40	20	25	40

## 2. Control Experiments

The first 6 groups are taken from the Laury, Walker, Williams (1995) study.

	Group 1				Group 2			
	Subject 1	Subject 2	Subject 3	Subject 4	Subject 5	Subject 6	Subject 7	Subject 8
R1	30	20	15	30	40	10	30	30
R2	30	30	30	35	40	20	40	35
R3	30	25	20	35	40	30	35	40
R4	40	23	30	37	40	15	40	40
R5	35	22	30	38	40	20	35	0
R6	30	23	40	39	40	5	40	20
R7	30	23	25	1	39	15	0	25
R8	30	20	40	40	40	15	0	40
R9	30	21	40	2	40	20	35	0
R10	30	20	40	3	40	20	35	5
R11	40	25	30	0	40	25	0	40
R12	40	19	28	0	40	20	0	0
R13	30	18	35	3	0	5	25	0
R14	40	15	20	4	30	20	0	0
R15	0	20	25	10	40	12	40	0

	Group 1				Group 2			
	Subject 1	Subject 2	Subject 3	Subject 4	Subject 5	Subject 6	Subject 7	Subject 8
R16	30	23	0	40	20	20	10	0
R17	37	23	0	0	0	10	15	0
R18	0	20	5	1	30	10	40	0
R19	30	10	3	2	40	10	0	40
R20	40	13	5	3	40	15	35	0
R21	30	15	8	4	25	15	25	0
R22	0	17	2	0	30	10	15	0
R23	30	5	10	5	40	10	25	0
R24	40	5	10	3	40	15	0	0
R25	37	5	13	3	0	10	5	0
R26	30	7	13	4	0	5	20	0
R27	30	5	6	20	20	5	40	0
R28	33	5	7	1	0	10	0	0
R29	0	5	12	3	10	5	10	0
R30	0	10	0	3	40	10	0	0

	Group 3				Group 4			
	Subject 9	Subject 10	Subject 11	Subject 12	Subject 13	Subject 14	Subject 15	Subject 16
R1	8	15	15	25	30	10	40	28
R2	15	20	40	30	30	20	40	38
R3	18	18	20	40	40	20	40	30
R4	10	10	16	39	35	35	40	35
R5	20	30	17	1	35	30	40	38
R6	1	5	16	20	30	25	35	34
R7	30	15	25	27	30	30	40	32
R8	22	15	26	30	30	0	35	32
R9	32	12	22	1	30	0	0	40
R10	1	10	25	5	30	20	0	34
R11	15	20	20	10	0	30	0	32
R12	19	0	25	13	30	0	0	38
R13	7	0	29	15	0	10	0	13
R14	18	10	20	16	0	15	0	32
R15	18	5	20	20	30	18	0	30
R16	15	10	21	16	30	20	0	30
R17	12	40	19	37	0	15	0	30
R18	10	30	19	35	10	0	0	32
R19	20	15	18	1	20	0	0	30
R20	12	5	19	6	0	5	0	0
R21	12	0	16	37	0	0	0	30
R22	20	0	18	1	10	0	0	34
R23	1	15	15	7	0	10	0	38
R24	10	13	16	7	30	5	0	36
R25	5	20	19	9	30	10	0	32
R26	12	10	21	28	0	5	0	30
R27	13	5	25	26	0	0	0	0
R28	11	7	23	1	0	0	0	0
R29	1	0	22	27	0	0	0	20
R30	1	0	19	1	0	0	0	5

	Group 5				Group 6			
	Subject 17	Subject 18	Subject 19	Subject 20	Subject 21	Subject 22	Subject 23	Subject 24
R1	30	30	40	20	20	9	10	10
R2	40	25	40	22	40	10	15	15
R3	0	15	40	26	10	16	20	30
R4	20	25	40	30	5	16	20	25
R5	35	28	40	25	1	14	20	40
R6	35	28	40	8	1	25	20	0
R7	0	15	40	0	1	15	15	5
R8	20	15	40	10	1	10	10	0
R9	35	20	40	20	1	20	15	15
R10	35	20	40	10	1	15	30	10
R11	0	25	40	9	1	17	30	10
R12	20	15	20	18	1	20	30	12
R13	5	18	25	26	20	25	35	14
R14	30	5	40	0	1	25	30	16
R15	30	10	5	20	1	5	25	14
R16	25	15	1	15	1	25	20	14
R17	10	5	0	34	1	30	25	15
R18	5	0	0	0	1	15	35	15
R19	0	0	5	40	1	20	20	25
R20	15	10	7	2	1	20	20	15
R21	5	5	0	22	1	25	20	14
R22	20	20	20	0	1	20	10	15
R23	20	15	5	20	1	15	20	15
R24	0	15	2	0	1	30	16	15
R25	20	0	9	0	1	20	20	15
R26	0	0	5	0	1	25	38	15
R27	10	15	40	0	1	25	25	15
R28	15	30	40	0	1	25	25	15
R29	30	10	0	8	1	30	26	15
R30	5	10	0	0	1	20	20	17

	Group 7				Group 8			
	Subject 25	Subject 26	Subject 27	Subject 28	Subject 29	Subject 30	Subject 31	Subject 32
R1	20	3	40	4	15	5	15	7
R2	30	20	40	6	23	10	5	8
R3	0	25	25	5	5	8	5	15
R4	15	35	1	7	12	0	5	2
R5	10	17	1	4	26	2	5	5
R6	0	20	1	6	4	0	8	20
R7	5	20	1	8	10	0	9	0
R8	9	5	1	2	2	12	1	5
R9	35	30	1	8	18	8	12	5
R10	30	30	15	4	0	10	11	10
R11	25	30	16	4	3	15	0	12
R12	5	32	1	5	10	0	8	9
R13	10	30	1	3	0	4	5	30
R14	0	25	1	4	40	15	0	0
R15	15	25	1	6	4	10	0	0

	Group 7				Group 8			
	Subject 25	Subject 26	Subject 27	Subject 28	Subject 29	Subject 30	Subject 31	Subject 32
R16	20	25	5	2	0	0	6	10
R17	15	25	3	10	5	4	4	15
R18	0	25	1	4	38	6	10	20
R19	30	15	10	12	0	8	8	18
R20	30	25	23	7	7	8	5	25
R21	28	25	30	5	2	4	20	0
R22	27	27	5	8	34	6	5	9
R23	25	27	5	10	22	10	0	10
R24	0	25	8	6	1	0	4	10
R25	0	23	1	12	0	12	5	40
R26	0	20	5	8	10	0	15	0
R27	0	20	15	16	0	4	6	17
R28	0	23	21	13	0	0	5	6
R29	0	25	25	20	28	0	3	0
R30	0	25	40	12	40	20	3	0

	Group 9				Group 10			
	Subject 33	Subject 34	Subject 35	Subject 36	Subject 37	Subject 38	Subject 39	Subject 40
R1	15	40	30	30	10	5	10	30
R2	20	40	40	35	25	9	40	30
R3	25	40	40	40	25	9	40	30
R4	17	40	40	40	3	20	20	30
R5	14	40	40	25	23	21	15	30
R6	18	40	40	30	40	26	10	30
R7	10	0	40	25	20	25	2	35
R8	13	40	40	35	35	29	0	30
R9	15	40	40	40	25	15	15	35
R10	17	30	40	25	20	25	10	30
R11	16	40	40	35	0	19	10	35
R12	17	40	40	40	26	17	15	30
R13	19	40	40	40	28	20	15	30
R14	21	40	40	35	35	25	15	25
R15	17	40	40	35	20	25	15	20
R16	18	40	40	40	35	35	15	20
R17	17	40	40	38	20	20	17	20
R18	18	40	40	40	15	25	14	25
R19	17	40	40	40	40	17	15	20
R20	16	40	40	40	40	13	40	20
R21	17	40	40	30	30	39	40	20
R22	18	40	40	30	30	30	0	20
R23	15	40	40	30	29	23	0	20
R24	17	40	40	32	35	1	15	30
R25	16	0	40	35	35	20	12	30
R26	22	40	40	40	25	3	15	25
R27	24	40	40	40	39	35	15	20
R28	25	40	35	40	25	3	0	30
R29	23	40	30	40	27	39	20	20
R30	20	40	25	0	30	25	12	20

	Group 11				Group 12			
	Subject 41	Subject 42	Subject 43	Subject 44	Subject 45	Subject 46	Subject 47	Subject 48
R1	40	35	25	10	20	15	20	15
R2	40	32	17	30	20	20	25	40
R3	40	37	19	20	0	24	27	40
R4	40	40	18	40	0	20	22	20
R5	40	39	15	10	10	15	15	2
R6	40	30	22	20	30	0	12	40
R7	40	0	17	30	0	0	12	20
R8	40	2	19	0	0	20	9	25
R9	40	5	0	0	0	5	15	40
R10	0	20	22	10	0	5	12	40
R11	0	15	0	0	0	10	5	0
R12	20	0	0	5	0	0	3	0
R13	0	10	30	15	20	40	3	0
R14	0	20	25	25	10	0	18	40
R15	0	22	23	30	0	5	20	40
R16	20	25	23	25	0	10	20	40
R17	30	40	27	35	0	15	25	35
R18	35	38	17	30	0	17	30	35
R19	30	20	19	5	0	5	30	33
R20	0	20	25	0	0	0	24	40
R21	0	0	0	40	0	5	18	35
R22	0	1	20	0	0	15	40	40
R23	0	1	35	15	0	20	36	40
R24	25	10	30	0	0	22	32	40
R25	25	20	20	25	20	5	35	0
R26	40	0	25	25	10	5	25	0
R27	40	10	10	20	40	0	15	20
R28	0	11	19	35	0	5	5	25
R29	0	0	0	0	0	0	0	0
R30	0	0	0	0	40	0	0	0

	Group 13			
	Subject 49	Subject 50	Subject 51	Subject 52
R1	40	0	25	40
R2	30	3	40	30
R3	0	10	40	30
R4	0	15	20	30
R5	0	10	0	0
R6	10	20	40	40
R7	10	20	40	35
R8	15	25	0	35
R9	40	5	0	40
R10	40	10	40	30

	Group 13			
	Subject 49	Subject 50	Subject 51	Subject 52
R11	30	15	40	35
R12	10	40	40	35
R13	20	25	40	36
R14	20	25	0	30
R15	30	15	0	40
R16	20	30	0	25
R17	25	30	0	27
R18	20	25	40	28
R19	15	30	40	29
R20	35	40	40	30
R21	30	40	40	35
R22	30	40	35	36
R23	30	40	40	34
R24	30	40	40	35
R25	30	40	40	34
R26	30	25	40	35
R27	30	25	30	40
R28	25	30	30	35
R29	40	30	40	33
R30	30	40	0	35

## CHAPTER 5

### Concluding Remarks

This dissertation examines experiments using the traditional voluntary contributions mechanism in which opportunities for reciprocal behavior are expanded in an effort to facilitate cooperation. Chapter 2 and 3 build on the literature examining opportunities to reward or sanction other group members within the VCM using a one-shot environment that eliminates the possibility of the use of sanctions or rewards for strategic purposes. Chapter 4 provides an analysis of the effect of binding multi-round commitment opportunities within a repeated VCM.

In chapters 2 and 3, the effect of opportunities to reward or sanction are examined in a one-shot VCM design that has so far been unexplored by the literature. Previous VCM studies allowing subjects to reward or sanction other group members have used a repeated multi-round design. Within the one-shot design of chapters 2 and 3, rewarding and sanctioning cannot be used in an effort to influence the behavior of other group members in future rounds. This allows the strategic motivation of rewards and sanctions to be separated from a purely reciprocal motivation, as only the purely reciprocal motivation is possible in the one-shot design.

Chapter 2 finds that some subjects are willing to reward and sanction other subjects at a personal cost within one-shot environments, providing strong evidence of reciprocal motivations on the part of experimental subjects. However, opportunities to reward or sanction other subjects within the one-shot design are not effective in increasing cooperation in the VCM relative to the *baseline VCM* without reward or sanction opportunities. This provides a counterpoint to the results of multi-

round studies of sanctions and rewards in which cooperation is enhanced. Further, chapter 2 compares behavior in decision situations in which the imposition of rewards and sanctions is certain to decision situations in which imposition is uncertain. The expected value of the reward or sanction is kept constant across environments to focus simply on the effect of uncertainty about imposition. Uncertainty does not change behavior in a significant way, either in the level of cooperation or the willingness of individuals to impose rewards or sanctions.

A possible reason that opportunities to reward or sanction did not enhance VCM cooperation in chapter 2 was that the possible reward or sanction a subject could expect to receive was too small to significantly influence VCM behavior. Chapter 3 examines opportunities to reward or sanction in which the cost of imposing a rewards or sanction varies relative to the cost of imposition, using the same one-shot environment of chapter 2.

In the *high sanction* and *high reward* decision situations of Chapter 3, the effect of a sanction or reward on the earnings of other group members is doubled relative to the reward or sanction opportunities of Chapter 2, but the imposition cost of the sanctions and rewards is identical to Chapter 2. In the *high sanction* decision situation, cooperation in the VCM is increased relative to the *baseline VCM* decision situation in which sanction or reward opportunities did not exist. This demonstrates that sanctioning opportunities, if strong enough, can encourage cooperation even in a one-shot environment in which it is impossible to influence the behavior of other group members in future rounds. Cooperation is not significantly enhanced in the

*high reward* decision situation relative to the *baseline VCM* decision situation, but the use of reward opportunities is expanded.

Chapter 4 explores the effect of opportunities to make binding multi-round commitments to the group account within a repeated VCM. Subjects are shown to be willing to make significant commitments when given the opportunity. Also, commitments are shown to strongly influence behavioral patterns within the VCM. However, commitment opportunities are shown to be ineffective in increasing overall average cooperation relative to control experiments.

Strong evidence of subjects following norms of reciprocity is found in Chapter 4. Subjects respond reciprocally to other subjects when deciding how large to make commitments, and also when deciding how much to increase group-account allocations above commitments. The results of chapter 4 are largely consistent with Bochet and Putterman (2004), a paper which studied non-binding numeral promises within the VCM. Although binding multi-round commitments have little effect on the average level of group-account allocations relative to the control experiments, commitments appear to cause a larger variance of group outcomes. Cooperative behavior is enhanced in cooperative groups, and uncooperative behavior becomes more pronounced in less cooperative groups.

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